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A PRELIMINARY LIST OF THE VERTEBRATE ANIMALS OF KENTUCKY.

By H. GARMAN, Lexington, Ky.

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THIS list is based upon collections and observations made since July, 1889, in various parts of Kentucky from points near the eastern limit of the State to Hickman on the Mississippi river. The original list, as thus prepared, has been extended by including species observed by Audubon, by Beckham in Spencer County, and very considerably by the use of the publications of the United States Fish Commission. Since the days of Audubon the bird fauna of the State has changed greatly, and his statements concerning the abundance of species are not in all cases to be accepted as applying at the present time. A few species which he observed here will probably not again be seen in Kentucky. Others which he recorded as occurring in great numbers are scarce. Some species, known to be

abundant at present, were not observed by him in the State and have probably increased in numbers since he collected. Facts of this sort will become more apparent when the list has been completed. It is published in its incomplete condition largely for the purpose of establishing a nucleus about which to build up a more thoroughgoing account of the vertebrate fauna of the State. The writer has given the mammals only incidental attention while engaged in other work. The list is very imperfect, especially in the small rodents, shrews and the like, a number of which have been observed but not studied. The lists of reptiles and amphibians probably do not contain more than half of our species. A good many which have been collected by me in southern Illinois, doubtless also occur on the Kentucky side of the Ohio river, but I have thought it best to include no species not actually taken in the State. A single month's active collecting in the more thinly settled parts of western Kentucky would doubtless add a number of these to the list. In collecting fishes my opportunities have been better than for the other groups, and I have been fortunate in having the aid of work done in the State by Commissioner McDonald's assistants. The list will probably be found to contain fully three-fourths of the Kentucky species.

My thanks are due to the managers of the Cincinnati Society of Natural History for the privilege of using a copy of Audubon's "Birds of North America," and especially to Mr. Seth Hayes for courtesy shown me during a recent visit to the library of this excellent institution.

MAMMALS.

CATS (Family Felidæ).

1. Panther, Cougar (*Felis concolor*, Linn.).

From accounts given me by intelligent men who

have long been familiar with the mountainous districts of Kentucky and West Virginia I am satisfied that this species has existed in the State within the past fifty years.

2. Wild Cat (*Lynx rufus*, Guld.).

This species still occurs in the mountains of eastern Kentucky. Captain Bent of Aden Springs informs me that a pair lived for some time in 1891 on a bluff near his residence, and that finally his dog treed one of them and it was shot.

DOGS (Family Canidæ).

3. Wolf (*Canis lupus*, Linn.).

Not common.

4. Gray Fox (*Urocyon cinereo-argentatus*, Schreber).

Formerly common. Still occurs in the mountain regions and occasionally in settlements.

5. Red Fox (*Vulpes vulpes*, Linn.).

Not rare. Occurs throughout Kentucky.

WEASELS (Family Mustelidæ).

6. Mink (*Putorius vison*, Schreber).

Occasionally taken in traps.

7. Skunk (*Mephitis mephitis*, Shaw).

Rather common everywhere. Sometimes enters caves, penetrating to a depth of two hundred feet or more.

BEARS (Family Ursidæ).

8. Black Bear (*Ursus americanus*, Pallas).

Formerly common, now rare, possibly not occurring at all.

RACCOONS (Family Procyonidæ).

9. Coon (*Procyon lotor*, Linn.).

Common everywhere. Young from the nest squeal when alarmed somewhat like a pig. The young also at times utter a low and rather musical trill resembling that commonly heard from the screech owl. This latter seems to be a call note probably employed to inform the parent that the young want food. When just able to run about they play like kittens, scampering after children, and worrying the end of a rope in evident enjoyment. One, kept by me for some time, ate freely of nearly everything given it: bread, meat, cabbage leaves, corn, insects; but had a special fondness for birds, becoming very irascible and suspicious of attentions while engaged in eating this kind of food. From the clamor of English sparrows in an elm tree up which this individual frequently climbed I suspect he was not above robbing nests of eggs or young.

BISON (Family Bovidæ).

10. Buffalo (*Bison bison*, Linn.).

Common in the early days of the settlement of Kentucky.

DEER (Family Cervidæ).

11. Elk (*Cervus canadensis*, Erxleben).

Long since exterminated in the State. With the buffalo it is said to have furnished a considerable part of the food supply of the pioneer settlers.

12. Deer (*Cariacus virginianus*, Boddaert).

Not common anywhere in Kentucky at present,

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but still occurs in both eastern and western ends of the State.

BATS (Family Vespertilionidæ).

13. Red Bat (*Atalapha noveboracensis*, Erxleben).

Taken at Lexington occasionally.

14. Long-eared bat (*Vesperugo serotinus*, Schreber).

An example of this was taken at the Experiment Farm, near Lexington, in August, 1893. The specimen is very dark in color, with large ears, and but little hair on the membranes. The outer of the two upper incisors is so small as to be made out with difficulty. The lower incisors are imbricated, the cutting edge of each with three rounded denticles.

15. Little Brown Bat (*Vespertilio subulatus*, Say).

Occurs in caves near Lexington, Ky.

Moles (Family Talpidæ).

16. Mole (*Scalops aquaticus*, Linn.).

Exceedingly common everywhere, and often troublesome in lawns and fields. It is accused by farmers of eating grain after it is planted. It undoubtedly devours large quantities of injurious insects.

SHREWS (Family Soricidæ).

At least one species of this family is common in pastures and cultivated ground at Lexington. I take it to be *Blarina parva*, but have not yet examined my material carefully enough to decide positively.

SQUIRRELS (Family Sciuridæ).

17. Flying Squirrel (*Sciuropterus volans*, Linn.).

I include this on the authority of Messrs. A. M. Peter and H. E. Curtis of the Kentucky Experiment Station. These gentlemen have observed it near Lexington.

18. Fox Squirrel (*Sciurus niger*, Linn.).
Kentucky (Audubon and Bachman).
19. Gray Squirrel (*Sciurus carolinensis*, Gmelin).
Very common in all parts of the State.
20. Ground Squirrel, Chipmunk (*Tamias striatus*, Linn.).
Very common about old rail fences.
21. Woodchuck, Ground-hog (*Arctomys monax*, Linn.).
Not rare.

MICE and RATS (Family Muridæ).

22. Wood Rat (*Neotoma floridana*, Say and Ord).
Some rodent which I presume to be this is rather common in caves throughout Kentucky, but its shyness is so great that one may visit its haunts scores of times without getting a glimpse of it. Captain Bent of Aden Springs tells me of a "cliff rat" which is probably the same species.
23. Muskrat (*Fiber zibethicus*, Linn.).
Common in all parts of Kentucky.

RABBITS (Family Leporidæ).

24. Rabbit (*Lepus sylvaticus*, Bachman).
A very common mammal in Kentucky and brought to market in winter by wagon loads.
Probably the marsh and water rabbits also occur in the State, but I have not yet recognized them among the many rabbits seen in the markets in a half dozen Kentucky cities.

OPOSSUMS (Family Didelphidæ).

25. Possum (*Didelphis virginiana*, Shaw).
Very common everywhere.

BIRDS.

THRUSHES (Family Turdidæ).

26. Bluebird (*Sialia sialis*, Linn.).
A common resident throughout Kentucky.
27. Robin (*Merula migratoria*, Linn.).
Resident and rather common.
28. Hermit Thrush (*Turdus aonalaschkæ*, Gmelin).
A common migrant. "Observed during spring and summer" (Aud.).
29. Olive-backed Thrush (*Turdus ustulatus*, Nuttall).
Common during the spring migrations.
30. Grey-cheeked Thrush (*Turdus aliciae*, Baird).
Nelson County, transient (Beckham).
31. Veery (*Turdus fuscescens*, Stephens).
Nelson County, transient, not common (Beckham).
32. Wood Thrush (*Turdus mustelinus*, Gmelin).
A summer resident. Common locally.

KINGLETS (Family Sylviidæ).

33. Blue-gray Gnat-catcher (*Polioptila cærulea*, Linn.).
A summer resident. Common everywhere during the spring migrations.
34. Ruby-crowned Kinglet (*Regulus calendula*, Linn.).
Common during both spring and fall. "In winter, but generally in southern exposures" (Aud.).
35. Golden-crowned Kinglet (*Regulus satrapa*, Licht.).
Very common in fall and spring.

NUTHATCHES (Family Paridæ).

36. Black-capped Chickadee (*Parus atricapillus*, Linn.).
"Extends as far as Kentucky in winter" (Aud.).
37. Chickadee (*Parus carolinensis*, Aud.).
A common resident throughout Kentucky.
38. Tufted Titmouse (*Parus bicolor*, Linn.).
One of the most abundant and characteristic Kentucky birds. Resident.
39. Red-bellied Nuthatch (*Sitta canadensis*, Linn.).
I have seen one example of this bird at Lexington, in fall. Beckham reports it as an irregular fall and winter visitant in Nelson County.
40. White-bellied Nuthatch (*Sitta carolinensis*, Latham).
A common and familiar species throughout the State. Resident.

CREEPERS (Family Certhiidæ).

41. Brown Creeper (*Certhia familiaris*, Linn.).
Common everywhere during fall and spring.
Winters in sheltered localities.

MOCKING BIRDS and WRENS (Family Troglodytidæ).

42. Short-billed Marsh Wren (*Cistothorus stellaris*, Lichtenstein).
Beckham reports having taken a male in Nelson County.
43. Winter Wren (*Troglodytes hiemalis*, Vieillot).
Occasional during winter and early spring. Beckham says it is rather common in Nelson County.
44. House Wren (*Troglodytes ædon*, Vieillot).
A rare bird in Kentucky, according to my experience. Its place about dwellings is occupied to some extent by the next. I have seen but one

specimen, captured in the State College hot house at Lexington in the spring of 1890.

45. Bewick's Wren (*Thryothorus bewickii*, Audubon).
Resident throughout the State. Common locally.
46. Carolina Wren (*Thryothorus ludovicianus*, Gmelin).
Very common everywhere. Resident.
47. Brown Thrush (*Harporhynchus rufus*, Linn.).
A moderately common, summer resident. Less common here than in the states along our northern border.
48. Catbird (*Galeoscoptes carolinensis*, Linn.).
A common summer resident.
49. Mocking Bird (*Mimus polyglottos*, Linn.).
Resident in all parts of the State. Becoming shy and rather scarce in the thickly settled regions, owing to persecution by boys and negroes who capture the young for "pets."

WAGTAILS (Family Motacillidæ).

50. Titlark (*Anthus pensilvanicus*, Latham).
Nelson County, transient (Beckham).

WARBLERS (Family Mniotiltidæ).

51. Redstart (*Setophaga ruticilla*, Linn.).
An abundant migrant in both fall and spring. Summer resident.
52. Canada Warbler (*Sylvania canadensis*, Linn.).
Kentucky (Aud.). Transient in Nelson County (Beckham).
53. Green, Black-capped Warbler (*Sylvania pusilla*, Wilson).
Transient in fall and spring. East Cairo in September. Nelson County, May (Beckham).

54. Hooded Warbler (*Sylvania mitrata*, Gmelin).
Along the Ohio river (Audubon). Transient,
Nelson County (Beckham).
55. Small-headed Warbler (*Sylvania* (?) *microcephala*,
Ridgway).
"I have never seen it out of Kentucky, and even
there it is a very uncommon bird" (Aud.). "Known
only from the works of Wilson and Audubon"
(Check-list Am. Orn. Union, 1886).
56. Yellow-breasted Chat (*Icteria virens*, Linn.).
A common summer resident throughout the State.
57. Maryland yellow-throat (*Geothlypis trichas*, Linn.).
A common summer resident.
58. Mourning Warbler (*Geothlypis philadelphia*, Wil-
son).
Transient in Nelson County (Beckham).
59. Connecticut Warbler (*Geothlypis agilis*, Wilson).
Transient, Nelson County (Beckham).
60. Kentucky Warbler (*Geothlypis formosa*, Wilson).
A summer resident. Common locally.
61. Large-billed Water Thrush (*Seiurus motacilla*,
Vieillot).
A summer resident.
62. Water Wagtail (*Seiurus noveboracensis*, Gmelin).
Canebrakes at Henderson and below (Aud.).
Nelson County (Beckham).
63. Oven Bird (*Seiurus aurocapillus*, Linn.).
Frequent in wooded regions in spring. A sum-
mer resident (?).
64. Red-poll Warbler (*Dendroica palmarum*, Gmelin).
Common near Lexington and elsewhere during
the fall migrations.
65. Prairie Warbler (*Dendroica discolor*, Vieillot).
Common in spring, probably a summer resident
in Nelson County (Beckham).

66. Pine-creeping Warbler (*Dendræca vigorsi*, Audubon).

Transient. Common in wooded regions.

67. Black-throated Green Warbler (*Dendræca virens*, Gmelin).

Transient. Common in fall and spring.

68. Orange-throated Warbler (*Dendræca blackburniæ*, Gmelin).

Transient. Beckham records it as common in Nelson County, in fall.

69. Yellow-throated Warbler (*Dendræca dominica*, Linn.).

Observed at Midland, Ky., in April, common. Common summer resident in Nelson County (Beckham).

70. Black-poll Warbler (*Dendræca striata*, Forster).

Transient. East Cairo, September, common. Nelson County (Beckham).

71. Bay-breasted Warbler (*Dendræca castanea*, Wilson).

Transient. East Cairo in September. Nelson County (Beckham).

72. Chestnut-sided Warbler (*Dendræca pensylvanica*, Linn.).

Transient; common in Nelson County (Beckham).

73. Cærulean Warbler (*Dendræca cærulea*, Wilson).

A summer resident.

74. Black and yellow Warbler (*Dendræca maculosa*, Gmelin).

Very common during the fall migrations in wooded regions.

75. Yellow-rumped Warbler (*Dendræca coronata*, Linn.).

A winter resident; common everywhere.

76. Black-throated blue Warbler (*Dendroæca cærulescens*, Linn.).

Transient; common, Nelson County (Beckham).

77. Summer Yellow Bird (*Dendroæca æstiva*, Gmelin).
Summer resident. Frequent.

78. Cape May Warbler (*Dendroæca tigrina*, Gmelin).

Transient. Rare in Nelson County (Beckham).

79. *Dendroæca carbonata*, Audubon.

Two specimens of this were killed by Audubon at Henderson, Ky., May, 1811. The species has not been collected since and ornithologists are in doubt as to its status. Audubon's account of the bird reads as follows: "I shot the two little birds, here represented, near the village of Henderson in the State of Kentucky, in May, 1811. They were both busily engaged in searching for insects along the branches and amongst the leaves of a dogwood tree. Their motions were those common to all the species of the genus. On examination they were found to be both males. I am of the opinion that they were each young birds of the preceding year, and not in full plumage, as they had no part of their dress seemingly complete, excepting the head. Not having met with any other individuals of the species, I am at this moment unable to say anything more about them. They were drawn like almost all other birds which I have represented, immediately after being killed."

80. Parula Warbler (*Compsothlypis americana*, Linn.).

Rather common during the fall migrations. A common summer resident in Nelson County (Beckham).

81. Nashville Warbler (*Helminthophila ruficapilla*, Wilson).

Kentucky (Aud.). Transient, not uncommon in Nelson County (Beckham).

82. Orange-crowned Warbler (*Helminthophila celata*, Say).

Transient, Nelson County (Beckham).

83. Tennessee Warbler (*Helminthophila peregrina*, Wilson).

Transient. East Cairo in September. Nelson County (Beckham).

84. Blue-winged Yellow Warbler (*Helminthophila pinus*, Linn.).

Frequent in the barrens (Audubon). Common in spring in Nelson County (Beckham).

85. Golden-winged Warbler (*Helminthophila chrysop-tera*, Linn.).

Kentucky, several specimens (Aud.). Rare, Nelson County (Beckham).

86. Worm-eating Warbler (*Helminthus vermivorus*, Gmelin).

In Kentucky and Ohio I have seen only a few of them; nor have I ever found their nests in either of these states (Aud.). The species is not rare during the nesting season in southern Illinois not far from the Kentucky border and hence is probably to be found breeding also on the Kentucky side of the Ohio river.

87. Prothonotary Warbler (*Protonotaria citrea*, Boddaert).

Observed by Audubon along the Ohio below Louisville. Probably not rare in the forests of western Kentucky. A specimen was observed by me at Midland in the eastern end of the State last April.

88. Black and White Creeper (*Mniotilta varia*, Linn.).

A summer resident in western Kentucky.

VIREOS (Family Vireonidæ).

89. White-eyed Vireo (*Vireo noveboracensis*, Gmelin).
A summer resident, Nelson County (Beckham).
90. Blue-headed Vireo (*Vireo solitarius*, Wilson).
Observed at Henderson and elsewhere in the State by Audubon. Not common. Nelson County (Beckham).
91. Yellow-throated Vireo (*Vireo flavifrons*, Vieillot).
Summer resident in Nelson County (Beckham).
92. Warbling Vireo (*Vireo gilvus*, Vieillot).
A common summer resident.
93. *Vireo philadelphicus*, Cassin.
Rare in Nelson County (Beckham).
94. Red-eyed Vireo (*Vireo olivaceus*, Linn.).
A common summer resident everywhere.

SHRIKES (Family Laniidæ).

95. Logger-head Shrike (*Lanius ludovicianus*, Linn.).
Apparently not common in Kentucky. I have never seen it in the State. Beckham appears to have observed it in Nelson County. Miss Sadie F. Price of Bowling Green has a water color sketch of a specimen obtained at that place.
96. Northern Shrike (*Lanius borealis*, Vieillot).
Audubon states that this shrike is not rare in Kentucky in winter. I have not seen it here, and am inclined to think it does not penetrate much beyond the Ohio River.

WAXWINGS (Family Ampelidæ).

97. Cedar Bird (*Ampelis cedrorum*, Vieillot).
Summer resident throughout the State. Frequent.

SWALLOWS (Family Hirundinidæ).

98. Rough-winged Swallow (*Stelgidopteryx serripennis*, Aud.).

A summer resident.

99. Bank Swallow (*Clivicola riparia*, Linn.).

According to Audubon this swallow produces two annual broods in Kentucky.

100. Barn Swallow (*Chelidon erythrogaster*, Boddært).

Abundant everywhere in summer.

101. Cliff Swallow (*Petrochelidon lunifrons*, Say).

Summer resident. Observed by Audubon, nesting at Newport in 1819.

102. Martin (*Progne subis*, Linn.).

A very abundant summer resident. At Lexington these birds assemble in the latter part of the summer in an immense flock. For several years they have made some maple trees on a retired corner of the State College grounds their place of assemblage. As early as July 4 they begin to gather on these trees to roost at night, coming at about 5 o'clock P. M. from the surrounding country for miles. In August thousands of the birds are every night gathered on these trees. When settling for the night they make a deafening clatter, quite unlike that produced when about their nests, and are so numerous that the branches sway and bend under them. On one occasion I secured a half-dozen specimens by throwing stones among them. They disappear suddenly about the 25th of August, though a few stragglers may be seen as late as Sept. 1, gathering upon the tower of the State College building of evenings.

One of the birds obtained on the College grounds

had fed very largely on a small brown beetle (*Colaspis brunnea*) which in its grub state sometimes does considerable mischief by eating the roots of strawberry plants.

Audubon observed martins at Louisville as early as March 15.

TANAGERS (Family Tanagridæ).

103. Scarlet Tanager (*Piranga erythromelas*, Vieillot).

A rather rare migrant in eastern Kentucky.

Audubon records it as plentiful in the State.

104. Summer Red Bird (*Piranga rubra*, Linn.).

A common summer resident throughout Kentucky. The nest with fresh eggs may often be seen from the middle of May to June 1. It is one of our most characteristic birds.

FINCHES (Family Fringillidæ).

105. Black-throated Bunting (*Spiza americana*, Gmelin).

A summer resident. Not very common. This is one of the birds mentioned by Mr. John Burroughs (see an article entitled "A Taste of Kentucky Blue-grass" in *The Century* for July, 1890) as characteristic of this region. The bird is not rare in some localities, but taking the State as a whole, cannot be ranked with such species as the red-headed woodpecker, the flicker, the summer red bird, the cardinal grosbeak, the Carolina wren, the crow, and the mocking bird. These are permanent residents and are common throughout the State. The black-throat occurs here only during the summer, and not a tithe of the individuals are to be seen in the State that occur on the prairies of states north of the Ohio River. The nests with

the pale, blue eggs may be found in tufts of grass during the first half of June.

Since the above was written, I have looked through Audubon's work, and find that he did not find the species common in Kentucky: "They are also abundant on the open lands of Missouri and Illinois; but rarer in Ohio, and scarce in Kentucky."

106. Indigo Bird (*Passerina cyanea*, Linn.).

Very common everywhere in summer.

107. Blue Grosbeak (*Guiraca cærulea*, Linn.).

Not a common bird. I have seen but one specimen.

108. Rose-breasted Grosbeak (*Habia ludoviciana*, Linn.).

Henderson (Aud.). Not common. Seen occasionally during spring.

109. Cardinal Grosbeak (*Cardinalis virginianus*, Linn.).

A common permanent resident.

110. Chewink (*Pipilo erythrophthalmus*, Linn.).

Frequent during the summer.

111. Fox Sparrow (*Passerella iliaca*, Merrem).

A winter visitant. Not rare.

112. *Melospiza lincolni*, Audubon.

Transient. Not uncommon in May in Nelson County (Beckham).

113. Swamp Sparrow (*Melospiza georgiana*, Latham).

Not very common. Occurs during the fall and spring.

114. Song Sparrow (*Melospiza fasciata*, Gmelin).

A very common, permanent resident.

115. *Peucæa æstivalis*, Lichtenstein.

This species has been observed by Miss Sadie F. Price at Bowling Green. It is probably not uncommon locally in western Kentucky. I have found it rather common in Illinois near our border.

116. Snow Bird (*Junco hyemalis*, Linn.).
A common winter visitant.
117. Field Sparrow (*Spizella pusilla*, Wilson).
A common summer resident.
118. Chippy (*Spizella socialis*, Wilson).
A common summer resident.
119. Tree Sparrow (*Spizella monticola*, Gmelin).
A common winter bird.
120. White-throated Sparrow (*Zonotrichia albicollis*, Gmelin).
A common winter visitant.
121. White-crowned Sparrow (*Zonotrichia leucophrys*, Forster).
Rather common in fall and spring. Probably winters in the forests of sheltered localities.
122. Lark Finch (*Chondestes grammacus*, Say).
Not common in blue grass Kentucky. Mr. Beckham reports it as a common summer resident in Nelson County.
123. *Ammodramus henslowi*, Audubon.
Audubon obtained a specimen in Kentucky, opposite Cincinnati, in 1820. Not common. Nelson County (Beckham).
124. Grasshopper Bird (*Ammodramus savannarum*, Gmelin).
Common everywhere in summer.
125. Savanna Sparrow (*Ammodramus sandwichensis*, Gmelin).
A common migrant in Nelson County (Beckham).
126. Vesper Sparrow (*Pooecetes gramineus*, Gmelin).
A common summer resident in the blue grass region. Becomes active and musical at sunset, and during sultry threatening weather. Audubon did not observe it in the State, from which it seems

probable it is extending its range to the westward. It is extremely common in the Shenandoah Valley of Virginia. Audubon writes: "I have never seen the Bay-winged Bunting in any portion of Louisiana, Missouri, Kentucky, or Ohio, and am therefore inclined to look upon it as a resident of the country lying to the eastward of the range of the Alleghanies."

127. Lapland Longspur (*Calcarius lapponicus*, Linn.).

On the 15th of February, 1819, Audubon says he saw immense flocks of this bird "scattered over the open grounds on the elevated grassy banks of the Ohio," at Henderson.

128. Snow Bunting (*Plectrophenax nivalis*, Linn.).

In the winter from Nova Scotia to Kentucky (Audubon).

129. Pine Siskin (*Spinus pinus*, Wilson).

Henderson (Aud.). Nelson County (Beckham).

130. Black-headed Goldfinch (*Spinus notatus*, Du Bus).

A Mexican species taken years ago in Kentucky by Audubon.

131. Goldfinch, Thistle Bird (*Spinus tristis*, Linn.).

A common summer resident. Remains with us during mild winters.

132. Red Crossbill (*Loxia curvirostra*, Linn.).

Nelson County (Beckham).

133. Purple Finch (*Carpodacus purpureus*, Gmelin).

I have not seen this bird in eastern Kentucky. It is recorded from Kentucky by Audubon. Beckham reports it a common migrant in Nelson County.

134. English Sparrow (*Passer domesticus*, Linn.).

Common everywhere. Often injurious to ripening wheat, sometimes making it necessary to keep a man in the fields with a shotgun.

BLACKBIRDS (Family Icteridæ).

135. Crow Blackbird (*Quiscalus quiscula*, Linn.).

A common summer resident. Raises its young very early in spring, and from the middle of June until the latter part of August or early September spends its time foraging in fields and collects at night to roost in clumps of evergreens in towns. Immense numbers of them often assemble at these roosts, and men and boys shoot them for food.

136. Rusty Blackbird (*Scolecophagus carolinus*, Müller).

I have not seen this species in the blue grass region. A common migrant in Nelson County (Beckham).

137. Baltimore Oriole (*Icterus galbula*, Linn.).

Moderately common during the summer.

138. Orchard Oriole (*Icterus spurius*, Linn.).

Less common than the preceding. A summer resident.

139. Meadow Lark (*Sturnella magna*, Linn.).

A permanent resident, but probably goes beyond our borders during severe winters. Moderately common in summer.

140. Red-winged Blackbird (*Agelaius phæniceus*, Linn.).

A moderately common, summer resident. Not as abundant as in the states north of us.

141. Cow Bird (*Molothrus ater*, Boddaert).

A common summer resident.

142. Bobolink (*Dolichonyx oryzivorus*, Linn.).

Not common. Miss Sadie F. Price has observed it at Bowling Green.

CROWS AND JAYS (Family Corvidæ).

143. Crow (*Corvus americanus*, Audubon).

Very common, permanent resident; often as-

sembles in flocks containing hundreds, and appears to migrate from one locality to another, though I am unable to say just what controls these movements.

144. Raven (*Corvus corax*, Linn.).

I am informed by an intelligent hunter that he has seen this bird occasionally in the mountains of eastern Kentucky.

145. Florida Jay (*Aphelocoma floridana*, Bartr.).

A Florida species said to have been taken in Kentucky. I include it only to call the attention of local observers to it. It is described by Dr. Coues as follows: "Not crested; wings and tail blue, not barred. Blue; back with a large well defined gray patch, belly and sides pale grayish, under tail coverts and tibiæ blue in marked contrast; much hoary whitish on forehead and sides of crown; chin, throat and middle of breast vague streaky whitish; ear coverts dusky; the blue that seems to encircle the head and neck well defined against the gray of the back and breast; bill comparatively short, very stout at the base. About 12; wing 5 or less; tail about 6, much rounded; bill about 1."

146. Blue Jay (*Cyanocitta cristata*, Linn.).

A common permanent resident.

LARKS (Family Alaudidæ).

147. Shore Lark, Horned Lark (*Otocoris alpestris*, Forster).

Occasionally seen in small flocks during the winter. Not as common as in the states north of the Ohio River.

FLYCATCHERS (Family Tyrannidæ).

148. Least Flycatcher (*Empidonax minimus*, Baird).
Transient in April and May, common, Nelson
County (Beckham).
149. Green-crested Flycatcher (*Empidonax acadicus*,
Gmelin).
Summer resident. Not rare.
150. Yellow-bellied Flycatcher (*Empidonax flaviventris*,
Baird).
Nelson County; transient (Beckham).
151. Wood Pewee (*Contopus virens*, Linn.).
Summer resident, common.
152. Pewee (*Sayornis phœbe*, Latham).
A common summer resident. Nests about old
quarries, and at the mouths of caves.
153. Great Crested Flycatcher (*Myiarchus crinitus*,
Linn.).
A common summer resident.
154. King Bird, Bee Bird (*Tyrannus tyrannus*, Linn.).
Common in summer.
155. Fork-tailed Flycatcher (*Milvulus tyrannus*, Linn.).
A tropical species occurring at intervals in wide-
ly separated localities in the U. S. Audubon
secured it in Kentucky and wrote of it as follows:
"Many years ago while residing at Henderson in
Kentucky, I had one of these birds brought to me
which had been caught by hand, and was nearly
putrid when I got it. The person who presented
it to me had caught it in the barrens, ten or twelve
miles from Henderson, late in October, after a
succession of white frosts, and had kept it more
than a week."

HUMMING BIRDS (Family Trochilidæ).

156. Ruby-throated Humming Bird (*Trochilus colubris*, Linn.).

A moderately common summer resident.

SWIFTS (Family Micropodidæ).

157. Chimney Swallow (*Chætura pelagica*, Linn.).

A very common, summer resident, probably nesting exclusively in unused chimneys. The chimney swift forms the subject of Audubon's animated account of a visit to a large hollow sycamore tree in which this bird collected at night to roost. By cutting a hole at the base he was able to enter the tree where he found the whole inside covered with birds and estimated that the tree contained 9,000.

GOATSUCKERS (Family Caprimulgidæ).

158. Night Hawk (*Chordeiles virginianus*, Gmelin).

A common summer resident.

159. Whippoorwill (*Antrostomus vociferus*, Wilson).

Not common in blue grass Kentucky, though it occurs in the vicinity of Lexington in spring. "The more barren and mountainous parts of the Union seem to suit it best. Accordingly the open Barrens of Kentucky, and the country through which the Alleghany ridges pass are more abundantly supplied with it than any other region" (Aud.).

WOODPECKERS (Family Picidæ).

160. Flicker, Yellow Hammer (*Colaptes auratus*, Linn.).

One of our most common birds. A permanent resident.

161. Red-bellied Woodpecker (*Melanerpes carolinus*, Linn.).

Frequent at all seasons throughout the State.

162. Red-headed Woodpecker (*Melanerpes erythrocephalus*, Linn.).

A very common, permanent resident. One of the characteristic Kentucky birds.

163. Logcock (*Ceophlæus pileatus*, Linn.).

Frequently seen in the less settled parts of the State. Becoming rather shy.

164. Yellow-bellied Woodpecker, Sap-sucker (*Sphyrapicus varius*, Linn.).

Occasional. Have seen but one example at Lexington.

165. Downy Woodpecker, Sap-sucker (*Dryobates pubescens*, Linn.).

A common permanent resident throughout the State.

166. Hairy Woodpecker, Sap-sucker (*Dryobates villosus*, Linn.).

Common. Permanent resident.

167. Ivory-billed Woodpecker (*Campephilus principalis*, Linn.).

Kentucky (Aud.).

KINGFISHERS (Family Alcedinidæ).

168. Kingfisher (*Ceryle alcyon*, Linn.).

Common along streams and about ponds in summer.

CUCKOOS (Family Cuculidæ).

169. Black-billed Cuckoo (*Coccyzus erythrophthalmus*, Wilson).

A summer resident. Not common.

170. Yellow-billed Cuckoo (*Coccyzus americanus*, Linn.).
A common summer resident.

PARROTS (Family Psittacidæ).

171. Carolina Paroquet (*Conurus carolinensis*, Linn.).

From being so common that its flesh was used as food, and it was shot as a pest in grain fields, this bird has become nearly exterminated except in Florida, and probably does not now occur in Kentucky. Even in Audubon's time the numbers had been greatly reduced, and he states that very few were to be found in Kentucky higher than Cincinnati, and that they were abundant only at the mouth of the Ohio.

OWLS (Family Bubonidæ).

172. Snowy Owl (*Nyctea nyctea*, Linn.).

Occasional in Kentucky during severe winters.

I have occasionally seen it in the lower part of Kentucky (Aud.).

173. Great Horned Owl (*Bubo virginianus*, Gmelin).

Not uncommon in forest-covered regions.

174. Screech Owl (*Megascops asio*, Linn.).

Our most abundant owl. Nests even in the edges of cities.

175. Barred Owl (*Syrnium nebulosum*, Forster).

Rather common in the bottomlands of western Kentucky.

176. Short-eared Owl (*Asio accipitrinus*, Pallas).

Occasionally observed near Lexington. Nelson County, rare (Beckham). By no means scarce (Aud.).

177. Long-eared Owl (*Asio wilsonianus*, Lesson).

Lexington, Ky., not very common. Observed

in the Barrens by Audubon and said by him to be "not very rare."

BARN OWLS (Family Strigidæ).

178. Barn Owl (*Strix pratincola*, Bonaparte).

Occasional examples of this bird are secured at Lexington. Several have been brought to me by persons who regarded them as great rarities.

HAWKS and EAGLES (Family Falconidæ).

179. Fish Hawk (*Pandion haliaetus*, Linn.).

Occasional. Audubon observed several pairs each year nesting on the Ohio River opposite the falls.

180. Sparrow Hawk (*Falco sparverius*, Linn.).

A permanent resident. Very common; often seen about buildings, apparently after English sparrows.

181. Pigeon Hawk (*Falco columbarius*, Linn.).

Bowling Green (Miss Sadie F. Price).

182. Bald Eagle (*Haliaetus leucocephalus*, Linn.).

Audubon found the nest of this eagle, with young, at the mouth of the Green River. A large example was brought to the State College, some years ago, that was killed near Lexington.

183. Chicken Hawk (*Buteo lineatus*, Gmelin).

A permanent resident in Nelson County. Abundant throughout the State.

184. Hen Hawk (*Buteo borealis*, Gmelin).

Lexington. Bowling Green (Miss Price).

185. Goshawk (*Accipiter atricapillus*, Wilson).

I have found them rather abundant in the lower parts of Kentucky (Aud.).

186. Chicken Hawk (*Accipiter cooperi*, Bonaparte).
Lexington. Nelson County (Beckham). Bowling Green (Miss Price).
187. Sharp-shinned Hawk (*Accipiter velox*, Wilson).
Lexington. Observed breeding along the Ohio (Aud.). Nelson County; a common permanent resident (Beckham).
188. Marsh Harrier (*Circus hudsonius*, Linn.).
Observed nesting in the barrens by Audubon. Lexington, occasional.
189. Swallow-tailed Kite (*Elanoides forficatus*, Linn.).
"Near the falls of the Ohio a pair had a nest and reared four young ones in 1820. In the lower part of Kentucky it begins to become more numerous" (Aud.).

VULTURES (Family Cathartidæ).

190. Carrion Crow (*Catharista atrata*, Bartram).
Tyrone. Nelson County (Beckham). According to Audubon it continues during the whole year in Kentucky.
191. Turkey Buzzard (*Cathartes aura*, Linn.).
A very common permanent resident throughout Kentucky.

PIGEONS (Family Columbidae).

192. Turtle Dove (*Zenaidura macroura*, Linn.).
A moderately common summer resident.
193. Wild Pigeons (*Ectopistes migratorius*, Linn.).
Not common. Have never seen it in the blue grass region. When one listens to the accounts of the great numbers of this harmless bird which occurred in Kentucky only fifty years ago, he cannot but speculate on the final outcome of Man's destructiveness.

PHEASANTS (Family Phasianidæ).

194. Wild Turkey (*Meleagris gallopavo*, Linn.).

This fine bird still occurs in small numbers in unsettled districts of both eastern and western Kentucky.

GROUSE (Family Tetraonidæ).

195. Prairie Chicken (*Tympanuchus americanus*, Reich.).

The prairie chicken probably does not now occur anywhere in Kentucky. Like the buffalo and paroquet it has been completely exterminated for many years. I have conversed with men now over eighty years old who have spent all their lives in eastern Kentucky and do not remember having seen or heard this grouse. It probably persisted longer in the western end of the State, for Audubon, who settled at Louisville about 1819, writes: "When I first removed to Kentucky, the Pinnated Grouse were so abundant that they were held in no higher estimation as food than the most common flesh, and no 'hunter of Kentucky' deigned to shoot them."

196. Pheasant, Partridge (*Bonasa umbellus*, Linn.).

A permanent resident in all parts of the State. Frequently seen in the market.

197. Quail (*Colinus virginianus*, Linn.).

A very common permanent resident. Large numbers may be seen in the markets of our towns during the winter months.

PLOVERS (Family Charadriidæ).

198. Killdeer (*Ægialitis vocifera*, Linn.).

A common summer resident.

199. Golden Plover (*Charadrius dominicus*, Müller).
Occasional in spring in the vicinity of Lexington.

SNIFE (Family Scolopacidæ).

200. Tip-up (*Actitis macularia*, Linn.).
Transient in spring, rather common, Nelson County (Beckham).
201. Willet (*Symphemia semipalmata*, Gmelin).
Shores of the Ohio (Aud.).
202. Upland Plover (*Bartramia longicauda*, Beckstein).
Kentucky (Aud.). Observed at Lexington on one occasion only, in September.
203. Solitary Tattler (*Totanus solitarius*, Wilson).
Lexington. Nelson County (Beckham).
204. Semipalmated Sandpiper (*Ereunetes pusillus*, Linn.).
Audubon observed large flocks at Henderson.
205. Least Sandpiper (*Tringa minutilla*, Vieillot).
East Cairo in September.
206. Wilson's Snipe (*Gallinago delicata*, Ord).
Rather common in spring.
207. Woodcock (*Philohela minor*, Gmelin).
Observed in fall and early spring. A few are brought in by hunters. Beckham thinks it breeds in Nelson County.

PHALAROPES (Family Phalaropodidæ).

208. Red Phalarope (*Crymophilus fulicarius*, Linn.).
A flock was observed by Audubon in 1808 at Louisville.
209. Wilson's Phalarope (*Phalaropus tricolor*, Vieillot).
Kentucky (Aud.).

RAILS (Family Rallidæ).

210. Coot (*Fulica americana*, Gmelin).
Common in the fall of the year.
211. Florida Gallinule (*Gallinula galeata*, Licht.).
A young bird, nearly grown, was brought to me
Oct. 4, 1893, by a colored man who stated that
he had caught it in a trap set in the country near
Lexington.
212. Purple Gallinule (*Ionornis martinica*, Linn.).
Beckham reports having seen an example of this
species in Nelson County many years ago.
213. Yellow Crake (*Porzana noveboracensis*, Gmelin).
Transient, rare; Nelson County (Beckham).
214. Carolina Rail (*Porzana carolina*, Linn.).
Transient, rather common in fall; Nelson County
(Beckham).
215. Virginia Rail (*Rallus virginianus*, Linn.).
Audubon observed a female with eggs in April
at Henderson. Transient, rare; Nelson County
(Beckham).
216. King Rail (*Rallus elegans*, Audubon).
Henderson (Aud). Bowling Green (Miss
Price).

CRANES (Family Gruidæ).

217. Sand-hill Crane (*Grus mexicana*, Müller).
Nelson County (Beckham).
218. Whooping Crane (*Grus americana*, Linn.).
Kentucky (Aud.) Nelson County (Beckham).

HERONS (Family Ardeidæ).

219. Night Heron (*Nycticorax nycticorax*, Linn.).
Transient, not common, Nelson County (Beck-
ham).

220. Green Heron (*Ardea virescens*, Linn.).

Very common in summer. The nest, consisting of loosely placed sticks, may be found with fresh eggs about the middle of May. It is sometimes placed in an orchard some distance from water.

221. Snowy Egret (*Ardea candidissima*, Gmelin).

Nelson County (Beckham).

222. Great White Egret (*Ardea egretta*, Gmelin).

East Cairo, September. Nelson County (Beckham).

223. Blue Heron (*Ardea herodias*, Linn.).

Rather common in summer.

224. Bittern, Indian Hen (*Botaurus lentiginosus*, Montagu).

Probably not common anywhere in Kentucky, as Audubon states that he never saw or heard the species in the State. A fine example, taken at Lexington, Sept. 25, 1893, had eaten nothing but grasshoppers. Transient, not common, Nelson County (Beckham).

STORKS (Family Ciconiidae).

225. Wood Ibis (*Tantalus loculator*, Linn.).

Observed by me at East Cairo in September.

DUCKS and GEESE (Family Anatidae).

226. Trumpeter Swan (*Olor buccinator*, Richardson).

In ponds about Henderson, during mild winters, until the beginning of March (Aud.).

227. Wild Goose (*Branta canadensis*, Linn.).

Common during the migrating season in spring.

228. White-fronted Goose (*Anser albifrons*, Gmelin).

Kentucky (Aud.).

229. Snow Goose (*Chen hyperborea*, Pallas).

- The young arrive at Henderson in the beginning of October, the adults a fortnight later (Aud.).
230. Dipper, Buffle-head (*Charitonetta albeola*, Linn.).
Ohio River (Aud.).
231. Golden Eye (*Glaucionetta clangula*, Linn.).
Henderson (Aud.).
232. Ring-necked Duck (*Athya collaris*, Donovan).
Kentucky (Aud.); Nelson County (Beckham).
233. Flocking Fowl, Scaup Duck (*Athya marila*, Linn.).
Kentucky (Aud.).
234. Wood Duck (*Aix sponsa*, Linn.).
A common summer resident in western Kentucky.
235. Pin-tail (*Dafila acuta*, Linn.).
Extremely abundant in Kentucky (Aud.).
236. American Widgeon (*Anas americana*, Gmelin).
Kentucky; remaining all winter when the weather is mild (Aud.).
237. Green-winged Teal (*Anas carolinensis*, Gmelin).
Transient. Rather common.
238. Blue-winged Teal (*Anas discors*, Linn.).
Ohio river in September and October; abundant (Aud.).
239. Black Duck (*Anas obscura*, Gmelin).
According to Audubon this duck breeds along the Mississippi River as far up as its confluence with the Ohio.
240. Mallard (*Anas boschas*, Linn.).
A common migrant in western Kentucky.
Breeds in ponds in Kentucky lowlands (Aud.).
241. Hooded Merganser (*Lophodytes cucullatus*, Linn.).
Audubon records this as not uncommon near Louisville when he first moved there.
242. Red-breasted Merganser (*Merganser serrator*, Linn.).
Breeds in Kentucky (Aud.).

243. Merganser (*Merganser americanus*, Cassin).

Said by Audubon to have bred in the State when he first resided there.

PELICANS (Family Pelecanidæ).

244. White Pelican (*Pelecanus erythrorhynchus*, Gmelin).

Ohio River (Aud.).

GULLS (Family Laridæ).

245. Black Tern (*Hydrochelidon nigra*, Linn.).

Abundant at Louisville (Aud.).

246. Least Tern (*Sterna antillarum*, Lesson).

Ohio River, abundant (Aud.).

247. Common Tern (*Sterna hirundo*, Linn.).

Henderson (Aud.).

248. Bonaparte's Gull (*Larus philadelphia*, Ord).

Ohio River at Cincinnati in 1819 (Aud.).

249. Herring Gull (*Larus argentatus*, Brünnich).

Ohio River (Aud.).

250. Great Black-backed Gull (*Larus marinus*, Linn.).

Ohio River (Aud.).

LOONS (Family Urinatoridæ).

251. Black-throated Loon (*Urinator arcticus*, Linn.)

Ohio River (Aud.).

252. Common Loon (*Urinator imber*, Gunner).

I have seen several examples which were taken in eastern Kentucky.

DIVING BIRDS (Family Podicipidæ).

253. Dab Chick (*Podilymbus podiceps*, Linn.).

Rather common in ponds in the vicinity of Lexington. Resident.

REPTILES.

Family Emydidæ.

254. Box Turtle, Terrapin (*Cistudo carolina*, Linn.).
Common everywhere in the less settled regions.

Family Chelydridæ.

255. Snapping Turtle (*Chelydra serpentina*, Linn.).
Occurs everywhere in Kentucky. Very abundant in the ponds in the blue grass region.

Family Trionychidæ.

256. Soft-shelled Turtle (*Aspionectes spinifer*, Le S.).
Ohio River.
257. Soft-shelled Turtle (*Aspionectes nuchalis*, Agassiz).
Occurs in the headwaters of the Cumberland and Tennessee Rivers.
258. Soft-shelled Turtle (*Amyda mutica*, Le S.).
Ohio River.

Family Iguanidæ.

259. Brown Swift (*Sceloporus undulatus*, Daudin).
Common in all parts of the State. Apparently equally at home in the mountains of eastern Kentucky and in the forests of the extreme western end of the State.

Family Anguidæ.

260. Joint Snake (*Ophisaurus ventralis*, Linn.).
Observed only in the western end of the State, but probably occurring everywhere.

Family Scincidæ.

261. Blue-tailed Lizard (*Eumeces fasciatus*, Linn.).
Common throughout the State.

262. Ground Lizard (*Oligosoma laterale*, Say).

Apparently not common. Observed only in the western end of the State.

SNAKES (Family Colubridæ).

263. Garter Snake (*Thamnophis sirtalis*, Linn.).

Very common everywhere. The variety *ordinata* is occasionally seen at Lexington.

264. Water Snake (*Nerodia sipedon*, Linn.).

Common about streams. The varieties *fasciatus* and *erythrogaster* have been taken on several occasions at Lexington.

265. Water Snake (*Regina leberis*, Linn.).

Rather common about ponds and streams near Lexington.

266. *Storeria occipitomaculata*, Storer.

A specimen collected near Mammoth Cave by Dr. B. F. Shumard is in the National Museum at Washington.

267. Green Snake (*Philophyllophis æstivus*, Linn.).

Moderately common throughout the State.

268. Black Snake, Blue Racer, (*Coluber constrictor*, Linn.).

Common everywhere.

269. Pilot Snake (*Elaphis obsoletus*, Say.).

Common everywhere, but especially abundant in the mountains.

270. House Snake, Chicken Snake, Milk Snake (*Ophibolus triangulus*, Boie).

Moderately common in all parts of the State.

271. Chain Snake, King Snake, Thunder Snake (*Ophibolus getulus*, Linn.).

Taken only at Midland, Ky., but probably occurs throughout the State, as I have collected specimens across the Ohio River in Illinois.

272. Spreading Adder (*Heterodon platyrhinus*, Latreille).
Common everywhere.
273. Worm Snake (*Carphophis amœnus*, Say.).
Found throughout Kentucky, but not as common as the next.
274. Worm Snake (*Carphophis helenæ*, Kennicott).
Very abundant throughout the State. Especially common under stones and logs along the Kentucky River. Probably a variety of the preceding, from which it differs only in lacking the anterior pair of prefrontals. It occurs with the other form, but twenty of this occur to one of *C. amœnus*. A specimen taken at Tyrone, Ky., is intermediate in the character of its prefrontals, having only one of the anterior pair present.

RATTLE SNAKES (Family Crotalidæ).

275. Timber Rattle Snake *Crotalus horridus*, Linn.).
Rather common in the mountainous regions.
276. Diamond Rattle Snake (*Crotalus adamanteus*, Beauv.).
This species is said to occur in mountains of eastern Kentucky. I have not yet seen an example.
277. Copperhead (*Agkistrodon contortrix*, Linn.).
Occurs in mountainous regions of the eastern end of the State.
278. Water Moccasin (*Agkistrodon piscivorus*, Holbr.).
Occurs about bayous in the western end of the State. Said to be common in Reelfoot Lake.

AMPHIBIANS.

FROGS (Family Ranidæ).

279. Leopard Frog (*Rana pipiens*, Schreber).

Very abundant throughout Kentucky. An inflation of the skin at the angles of the mouth, common here during the breeding season, has never been observed by me in the numerous specimens examined in Illinois. There is also a tendency to a loss of the anterior of the three dark spots on the head in Kentucky examples.

280. Green Frog, Spring Frog (*Rana clamitans*, Latr.).
Rather common in the eastern half of the State.
281. Bull Frog (*Rana catesbiana*, Shaw).
Common in western Kentucky.

TOADS (Family Bufonidæ).

282. Toad (*Bufo lentiginosus*, Shaw).
Very common everywhere. Especially noticeable in spring about ponds.

TREE TOADS (Family Hylidæ).

283. Cricket Frog (*Acris gryllus*, LeConte).
Common in the western end of the State about bayous.
284. Prairie Tree Frog (*Chorophilus triseriatus*, Wied.).
Observed thus far only at Nortonville towards the western end of the State.
285. Tree Toad (*Hyla versicolor*, LeConte).
Common everywhere.

NEWTS (Family Pleurodelidæ).

286. Newt, Eft (*Diemyctylus miniatus*, Raf.).
Occasional.

Family Desmognathidæ.

287. Dusky Salamander (*Desmognathus fusca*, Raf.).
Very abundant in and about springs and mountain rills in the eastern end of the State. Difficult

of capture because of its slimy skin and active wriggling. A female with a mass of eggs just hatching was recently (in September) found by Prof. C. W. Mathews among liverworts in a springy place along the Cumberland River at Burnside. The young soon acquire a series of red spots along each side. The gills of the young are well developed.

Family Plethodontidæ.

288. Cave Salamander (*Spelerpes longicauda*, Green).

Occurs throughout the State. Rather common; sometimes found within the mouths of caves, but quite as often under stones in woods.

289. Gray-spotted Salamander (*Plethodon glutinosus*, Green).

Distributed throughout the State. Rather common under logs and stones in woods.

290. Red-backed Salamander (*Plethodon erythronotus*, Green).

Abundant in the vicinity of Hopkinsville under stones and logs. Louisville is given as the locality for a specimen in the National Museum at Washington.

Family Ambystomidæ.

291. Tiger Salamander (*Ambystoma tigrinum*, Green).

A specimen is recorded by Dr. Yarrow as in the U. S. National Museum collection from Russellville.

292. Spotted Salamander (*Ambystoma punctatum*, Linn.).

Mr. Kirsch reports having taken a large number of this species in Rock Creek at Whitley Station, Kentucky.

Family Amphiumidæ.

293. Congo Snake (*Amphiuma means*, Linn.).

A specimen of this singular amphibian is in the National Museum collection from Jeffersonville, Indiana, hence it may be considered a Kentucky species.

FISHES.

COD-FISHES (Family Gadidæ).

294. Burbot, Ling (*Lota lota*, Linn.).

Ohio River, occasional.

SCULPINS (Family Cottidæ).

295. Miller's Thumb (*Cottus bairdi*, Girard).

Common throughout the State in springs and streams flowing from them. Often penetrates into caves, occurring as much as half a mile from the entrance. Not observed in the warmer surface waters.

SHEEPSHEAD (Family Sciænidæ).

296. Sheepshead, White Perch (*Aplodinotus grunniens*, Raf.)

Common in all the larger streams: Ohio River, Green River, Cumberland River, Tennessee River. Rolling Fork, Obion Creek, Bayou de Chien (Woolman).

BASS (Family Serranidæ).

297. Yellow Bass (*Morone interrupta*, Gill).

Ohio River at East Cairo.

298. White Bass (*Roccus chrysops*, Raf.).

Cumberland River, Tennessee River.

PERCH (Family Percidæ).

299. Sand Pike (*Stizostedion canadense*, C. H. Smith).
Common in the larger streams: Ohio River, Rockcastle River, Big Sandy River, Little Sandy River. Indian Creek, Clinton County (Kirsch).
300. Salmon, Wall-eye, Pike Perch (*Stizostedion vitreum*, Mitchill).
Common in the larger streams: Ohio River, Big Sandy River, Little Sandy River, Green River, Cumberland River and Tennessee River.
With the preceding this is sold in all our markets as "salmon."
301. Least Darter (*Etheostoma microperca*, Jordan and Gilbert).
Green River (Woolman).
302. *Etheostoma fusiforme*, Girard.
Tradewater River, Mayfield Creek, Bayou de Chien (Woolman).
303. *Etheostoma cœruleum*, Storer.
Very abundant in most small creeks in the eastern half of the State. Big Sandy River, Kentucky River and tributaries, Green River, Cumberland River. Rolling Fork, Licking River (Woolman). Indian Creek, Willis Creek, etc., in Clinton County (Kirsch), Otter Creek, Wayne County (Kirsch).
304. *Etheostoma virgatum*, Jordan.
Rockcastle River (Jordan), Green River (Woolman).
305. *Etheostoma sagitta*, Jordan and Swain.
Cumberland River (Jordan). Original description in Proc. U. S. Nat. Mus., 1883, p. 250. A single specimen was obtained from Wolf Creek in Whitley County. "Its long, naked, tapering head is its most striking peculiarity."

306. *Etheostoma obeyense*, Kirsch.

Small tributaries of the Cumberland River, in Clinton County (Kirsch). Original description in Bull. U. S. Fish Commission for 1890, p. 292. Beaver and Otter Creeks in Wayne County; very abundant (Kirsch).

307. *Etheostoma cinereum*, Storer.

Little South Fork and Rock Creek, tributaries of the Cumberland; scarce (Kirsch). For a description, see Bull. U. S. Fish Commission for 1891, p. 264 (printed in 1893).

308. *Etheostoma squamiceps*, Jordan.

Kentucky (Jordan).

309a. *Etheostoma flabellare*, Raf.

Very common in small streams in eastern Kentucky. Big Sandy River, Kentucky River, Rockcastle River, Green River. Licking River (Woolman). Indian Creek, Smith's Creek, in Clinton County (Kirsch).

309b. *Etheostoma flabellare* var. *cumberlandicum*, Jordan.

Original description in Proc. U. S. National Museum, 1883, p. 251. The types were taken by Dr. Jordan in Wolf Creek, Briar Creek and other small streams in Whitley County in May, 1883. "In all these streams this was the most abundant of the darters." It is said to have a thicker head than the type form, and to be plain olivaceous except for the black humeral spot.

310. *Etheostoma rufolineatum*, Cope.

Green River, Licking River (Woolman), Indian Creek in Clinton County (Kirsch).

311. *Etheostoma maculatum*, Kirtland.

Cumberland River, Licking River (Woolman).

312. *Etheostoma camurum*, Cope.
Green River, Cumberland River (Woolman).
313. *Etheostoma zonale*, Cope.
Big Sandy River, Kentucky River, Cumberland River, Green River.
314. *Etheostoma variatum*, Kirtland.
Kentucky River, Licking River (Woolman).
315. *Etheostoma histrio*, Jordan and Gilbert.
Green River (Woolman). Described in Proc.
U. S. Nat. Mus., 1887, p. 47.
316. *Etheostoma spilotum*, Gilbert.
Kentucky River (Jordan).
317. *Etheostoma cymatotænia*, Gilbert and Meek.
Green River (Woolman).
318. *Etheostoma evides*, Jordan and Copeland.
Ohio River, at Racoon Island (Henshall);
Green River (Woolman).
319. *Etheostoma ouachitæ*, Jordan and Gilbert.
Green River, Obion Creek (Woolman).
320. *Etheostoma scierum*, Swain.
Ohio River, near Little Sandy River (Henshall);
Green River, Little Sandy River (Woolman).
321. *Etheostoma phoxocephalum*, Nelson.
Big Sandy River, Cumberland River, Green River, Rolling Fork, Tradewater River (Woolman).
322. *Etheostoma aspro*, Cope and Jordan.
Big Sandy River, Kentucky River, Rockcastle River, Green River, Cumberland River, Tennessee River. Obion Creek, Bayou de Chien (Woolman).
323. *Etheostoma macrocephalum*, Cope.
Green River, Big Sandy River (Woolman).
324. *Etheostoma caprodes*, Raf.
Common throughout the State. Tributaries of Kentucky River, Rockcastle, River, Green River,

Cumberland River, Tennessee River. Obion Creek, Bayou de Chien (Woolman).

325. *Ettheostoma shumardi*, Girard.

Green River, Cumberland River, Obion Creek (Woolman).

326. *Ettheostoma copelandi*, Jordan.

Ohio River, at Racoon Island (Henshall).

Green River (Woolman).

327. *Ettheostoma blennioides*, Raf.

Common locally in eastern part of the State.

Big Sandy River, Kentucky River and tributaries, Green River, Cumberland River.

- 328a. *Ettheostoma simoterum*, Cope.

Rockcastle River, Green River, Cumberland River.

- 328b. *Ettheostoma simoterum*, var. *atripinnis*, Jordan.

Canada Creek, Wayne County (Kirsch).

329. *Ettheostoma susanæ*, Jordan and Swain.

The types were taken in small tributaries of the Cumberland River in Whitley County in 1883. The original description appeared in the Proc. U. S. Nat. Mus., 1883, p. 249.

330. *Ettheostoma stigmæum*, Jordan.

Green River, Cumberland River (Woolman).

Willis Creek, Clinton County (Woolman).

331. *Ettheostoma nigrum*, Raf.

Occurs everywhere in Kentucky. Big Sandy River, Little Sandy River. Kentucky River, Green River, Tennessee River, Bayou de Chien (Woolman).

332. *Ettheostoma asprellus*, Jordan.

Green River (Woolman).

333. *Ettheostoma pellucidum*, Baird.

Common locally in the larger streams. Big

Sandy River, Little Sandy River, Kentucky River, Green River, Cumberland River, Tennessee River.

SUN FISHES (Family Centrarchidæ).

334. Large-mouthed Black Bass (*Micropterus salmoides*, Lacépède).

Common throughout Kentucky. Big Sandy River, Little Sandy River, Kentucky River, Rockcastle River, Green River. Obion Creek, Bayou de Chien (Woolman).

335. Small-mouthed Black Bass (*Micropterus dolomieu*, Lacépède).

Not uncommon locally in the larger streams of eastern Kentucky. The young are frequently obtained from the small creeks. Big Sandy River, Little Sandy River, Kentucky River, Rockcastle River, Green River, Cumberland River, Tennessee River. Obion Creek, Bayou de Chien (Woolman).

336. *Lepomis heros*, Baird and Girard.

Common in bayous of bottoms along the Ohio River at East Cairo. Bayou de Chien (Woolman).

337. *Lepomis garmani*, Forbes.

Mr. Woolman seems to have taken this species in the Upper Cumberland at Barboursville and in the Bayou de Chien in the western end of the State. The types were collected by the writer in tributaries of the Wabash River in southern Illinois.

338. Long-eared Sun Fish (*Lepomis megalotis*, Raf.).

Abundant throughout the State. Big Sandy River, Little Sandy River, tributaries of Kentucky River, Green River, Cumberland River, Tennessee River. Obion Creek, Bayou de Chien (Woolman).

339. Common Sun Fish (*Lepomis pallidus*, Mitchill).

In the larger streams throughout Kentucky, Big Sandy River, City reservoir at Lexington, Cumberland River, Green River. Bayou de Chien (Woolman).

340. *Lepomis humilis*, Girard.

Tributaries of the Kentucky River; occasional.

341. *Lepomis macrochirus*, Raf.

Creeks in Whitley County (Jordan). Trade-water River, Obion Creek (Woolman).

342. Green Sun Fish (*Lepomis cyanellus*, Raf.).

Throughout the State, common. Sometimes called "peararch." It constitutes the greater part of the catches made by small boys and negroes who fish with hook and line in the numerous small ponds of blue grass Kentucky. Big Sandy River, tributaries of Kentucky, Green River, Cumberland River, Barnett's Creek in Trigg County.

343. War Mouth, Goggle Eye (*Chænobryttus gulosus*, Cuv. and Val.).

Western Kentucky, common. Green River, Barnett's Creek in Trigg County, Bayous at East Cairo. Obion Creek, Bayou de Chien (Woolman).

344. Rock Bass, Red Eye (*Ambloplites rupestris*, Raf.).

Not rare in the eastern part of Kentucky. Ohio River, Big Sandy River, Little Sandy River, Kentucky River, Rockcastle River, Green River, Cumberland River, Tennessee River.

345. New Light, Pale Crappie (*Pomoxis annularis*, Raf.).

Very abundant in ponds in eastern Kentucky, and common also in bayous in the extreme western end of the State. Ohio River, Little Sandy River, Kentucky River, Green River, Bayous at East Cairo.

346. Dark Crappie, Calico Bass (*Pomoxis sparoides*, Raf.).
Obion Creek, Bayou de Chien (Woolman). I
have not yet seen this species in eastern Ken-
tucky.
347. (*Centrarchus macropterus*, Lacépède)
Barnett's Creek in Trigg County. Mayfield
Creek (Woolman).

TINY PERCHES (Family Elasmomatidæ).

348. *Elassoma zonatum*, Jordan.
This species has been collected by me on the Illi-
nois side of the Ohio near Cairo and also across
the Mississippi River at Bird's Point, Missouri.
There can be no doubt that it occurs also in the
bayous on the Kentucky side.

PIRATE PERCHES (Family Aphredoderidæ).

349. Pirate Perches (*Aphredoderus sayanus*, Gilliams).
Western Kentucky, Barnett's Creek in Trigg
County. Green River, Mayfield Creek, Obion
Creek, Bayou de Chien (Woolman).

SILVERSIDES (Family Atherinidæ).

350. Brook Silversides (*Labidesthes sicculus*, Cope).
Common throughout Kentucky, Big Sandy River,
Little Sandy River, tributaries of Kentucky River,
Green River, Cumberland River, Tennessee River.
Obion Creek, Bayou de Chien (Woolman).

EELS (Family Anguillidæ).

351. Eel (*Anguilla anguilla*, Linn.).
Ohio River, Rockcastle River, Cumberland
River, Bayou de Chien (Woolman).

PICKEREL (Family Esocidæ).

352. Little Pickerel (*Esox vermiculatus*, Le S.).

Barnett's Creek in Trig County. Mayfield Creek, Obion Creek, Bayou de Chien (Woolman).

353. Mascalonge (*Esox nobilior*, Thompson).

"I have seen heads of large pike from several streams in eastern Ohio and northwestern Kentucky, said to have weighed from thirty to forty pounds, and there were no specific differences between them and those of the mascalonge of the Great Lakes" (Dr. J. A. Henshall).

TOP MINNOWS (Family Cyprinodontidæ).

354. *Gambusia patruelis*, Baird and Girard.

Western Kentucky. Cumberland River, Obion Creek (Woolman).

355. *Zygonectes notatus*, Raf.

Common throughout most of the State. Tributaries of Kentucky River, Green River, Cumberland River. Mayfield Creek, Obion Creek, Bayou de Chien (Woolman).

356. *Fundulus catenatus*, Storer.

Green River, Tennessee River, Indian Creek, Willis Creek, in Clinton County (Kirsch). Beaver and Otter Creeks in Wayne County (Kirsch).

CAVE FISHES (Family Amblyopsidæ).

"Professor Ray Lankester, in a recent lecture at the Royal institution, thus attempted to account for the absence of eyes in the fishes in the famous underground Kentucky caves in the following way: A great flood carries to the bottom of the Ken-

tucky caves, some thirty miles below the surface, a number of fishes among whose very numerous offspring will be some defective in sight, as some babies are born blind, or without any eyes at all. The fish who can see some faint glimmerings of light will swim away toward that light, while those will remain that cannot perceive the gleams. This with every succeeding generation would occur, the stronger in sight swimming away and the weaker remaining, and as the breeding would therefore occur between those of the worst sight, fish would be born with weaker eyes and weaker until born blind."

The above is quoted from a newspaper, and probably does not in all respects report Professor Lankester correctly, since it is hardly to be supposed that he believes Mammoth Cave to penetrate the earth for a distance of thirty miles. But in the main it gives his theory as to the origin of cave animals correctly. It will probably strike the majority of those who are familiar with the caves simply as a curiosity in speculation. The views expressed by Herbert Spencer (Popular Science Monthly, XLIII, 487, 488) seem to me much more sound and consistent with the facts:

"The existence of these blind cave-animals can be accounted for only by supposing that their remote ancestors began making excursions into the cave, and, finding it profitable, extended them, generation after generation, further in, undergoing the required adaptations little by little."

357. *Chologaster agassizii*, Putnam.

Underground streams.

358. Blind Fish (*Typhlichthys subterraneus*, Girard).

Inhabits wells, caves and springs in the vicinity of Mammoth Cave.

359. Blind Fish (*Amblyopsis spelæus*, DeKay).

Subterranean waters in and about Mammoth Cave.

TROUT PERCHES (Family Percopsidæ).

360. Trout Perch (*Percopsis guttatus*, Agassiz).

Ohio River, occasional.

HERRINGS (Family Clupeidæ).

361. Hickory Shad (*Dorosoma cepedianum*, LeS.).

Throughout the State in the larger streams; common. Ohio River, Big Sandy River, Little Sandy River, Green River, Cumberland River, Tennessee River. Obion Creek, Bayou de Chien (Woolman).

362. Ohio Shad (*Clupea chrysochloris*, Raf.).

Ohio River at East Cairo and elsewhere; common. Little Sandy River (Woolman), Lower Cumberland River (Jordan), Willis Creek, Clinton County (Kirsch).

MOON-EYES (Family Hiodontidæ).

363. *Hiodon selenops*, Jordan and Bean.

Cumberland River (Jordan), Rolling Fork, Green River (Woolman).

364. Moon-eye (*Hiodon tergisus*, LeS.).

Ohio River, common; Cumberland River, abundant (Jordan).

365. *Hiodon alosoides*, Raf.

Ohio River. Cumberland River, Rolling Fork (Woolman).

MINNOWS (Family Cyprinidæ).

366. German Carp (*Cyprinus carpio*, Linn.).
Very common in ponds in eastern Kentucky.
Sometimes escapes into streams.
367. Shiner (*Notemigonus chrysoleucus*, Mitch.).
Western Kentucky. Barnett's Creek in Trigg County. Mayfield Creek, Bayou de Chien (Woolman).
368. *Opsopæodus bollmani*, Gilbert.
Three specimens of this were taken by Mr. Woolman in Obion Creek. According to him it has been taken only in one other locality, viz., Satilla River, Georgia.
369. *Opsopæodus emiliæ*, Hay.
Cumberland River, Mayfield Creek, Bayou de Chien (Woolman).
370. Horned Dace (*Semotilus atromaculatus*, Mitch.).
Common everywhere in Kentucky. Big Sandy River, Kentucky River and tributaries, Green River, Rockcastle River, Cumberland River. Bayou de Chien (Woolman).
371. Flat-headed Chub (*Platygobio gracilis*, Raf.).
A single specimen of this species was taken by Prof. S. A. Forbes and myself near East Cairo in the Ohio River.
372. *Hybopsis watauga*, Jordan and Everman.
Kentucky River, Green River, Tennessee River. The original description is in the Proc. U. S. Nat. Museum, XI, p. 355, pl. xlv, Fig. 9.
373. Horny Head (*Hybopsis kentuckiensis*, Raf.).
Common in eastern Kentucky in most streams. Big Sandy River, Kentucky River, Rockcastle

River, Green River, Tennessee River. Spring Creek, Smith's Creek, etc., in Clinton County (Kirsch), Beaver and Otter Creeks in Wayne County (Kirsch).

374. *Hybopsis storerianus*, Kirtland.

Throughout Kentucky. Little Sandy River, Kentucky River, Green River, Cumberland River, Tennessee River. Bayou de Chien (Woolman).

375. *Hybopsis amblops*, Raf.

Common throughout Kentucky. Ohio River at East Cairo, Big Sandy River, Little Sandy River, Kentucky River, Green River, Cumberland River, Tennessee River.

376. *Hybopsis dissimilis*, Kirtland.

Rolling Fork of Salt River (Woolman).

377. *Hybopsis hyostomus*, Gilbert.

Ohio River at Racoon Island (Henshall). Big Sandy River, Green River (Woolman).

378. Black-nosed Dace (*Rhinichthys atronasmus*, Mitchill).

Common locally in small tributaries of the Kentucky River. Common in clear cold streams in Whitley County (Jordan), Indian Creek, Willis, Smith's Creek, etc., in Clinton County (Kirsch).

379. *Phenacobius uranops*, Cope.

Rockcastle River, Green River, Cumberland River.

380. *Ericymba buccata*, Cope.

Common locally in Kentucky River; Little Sandy River, Big Sandy River, Cumberland River.

381. *Notropis micropteryx*, Cope.

Rockcastle River, abundant (Jordan).

382. *Notropis arge*, Cope.

Green River, Kentucky River (Woolman).

383. *Notropis atherinoides*, Raf.

Throughout Kentucky; common. Little Sandy

- River, Big Sandy River, Kentucky River, Green River, Cumberland River, Tennessee River. Bayou de Chien (Woolman).
384. *Notropis dilectus*, Girard.
Big Sandy River, Kentucky River, Green River, Cumberland River, Tennessee River.
385. *Notropis telescopus*, Cope.
Green River (Woolman). Willis Creek, Indian Creek, in Clinton County (Kirsch).
386. Red-fin (*Notropis ardens*, Cope).
Tributaries of Kentucky River, Cumberland River, Rockcastle River, Green River.
387. *Notropis ariommus*, Cope.
Kentucky River, Green River, Big Sandy River.
388. *Notropis jejunus*, Forbes.
Ohio River at East Cairo, Little Sandy River, Big Sandy River, Cumberland River.
389. *Notropis leuciodus*, Cope.
Five specimens were collected in Smith's Creek, Clinton Co., by Mr. Philip H. Kirsch.
390. *Notropis coccogenis*, Cope.
Big Sandy River (Woolman).
391. Shiner (*Notropis megalops*, Raf.).
Occurs throughout Kentucky. Big Sandy River, Kentucky River, Rockcastle River, Green River, Cumberland River, Tennessee River. Obion Creek (Woolman).
392. *Notropis galacturus*, Cope.
Rockcastle River, Cumberland River, Willis Creek, Spring Creek, etc., in Clinton County (Kirsch), Beaver and Otter Creeks in Wayne County (Kirsch).
393. *Notropis whipplei*, Girard.
Everywhere, common. Little Sandy River, Big Sandy River, Kentucky River, Green River, Cum-

berland River, Tennessee River, Bayou de Chien (Woolman).

394. *Notropis deliciosus*, Girard.

Occurs throughout the State. Big Sandy River, Kentucky River, Green River, Cumberland River, Tennessee River.

395. *Notropis spectrunculus*, Cope.

Cumberland River, Kentucky River.

396. *Notropis heterodon*, Cope.

Canada Creek, Wayne County, two small specimens (Kirsch). Jordan took in 1883 in Wolf County and Clear Fork, Whitley County, several specimens of a fish which he named *Hemitremia vittata*, Cope, but subsequently decided that the latter name was a synonym of the above.

397. Bull-headed Minnow (*Cliola vigilax*, Baird and Girard).

Kentucky River, common; Big Sandy River, Cumberland River.

398. *Pimephales notatus*, Raf.

Occurs everywhere in the State. Big Sandy River, Green River, Rockcastle River, Cumberland River, Tennessee River, Bayou de Chien.

399. *Pimephales promelas*, Raf.

Tributaries of the Kentucky River, common locally. This small minnow was described by the eccentric Rafinesque, once connected with the old Transylvania University, from a single specimen said to have been obtained from Mr. W. M. Clifford of Lexington, Kentucky, in 1820. The species is especially common in the North Elkhorn at Bryant Station, about six miles north of Lexington. A few specimens have been taken in the Kentucky River at Clay's Ferry.

400. *Hybognathus nuchalis*, Agassiz.

Occurs throughout Kentucky. Ohio River at East Cairo, Big Sandy River, Little Sandy River, Green River, Cumberland River, Tennessee River.

401. Red-bellied Minnow (*Chrosomus erythrogaster*, Raf.).
Rockcastle River, Cumberland River.

402. Stone Roller (*Compostoma anomalum*, Raf.).

One of our most common minnows, occurring throughout the State. Big Sandy River, Kentucky River, Green River, Cumberland River, Tennessee River, Barnett's Creek in Trigg County.

SUCKERS (Family Catostomidæ).

403. Hare-lip Sucker (*Lagochila lacera*, Jordan and Brayt.).

Little Sandy River, Cumberland River (Kirsch).

404. *Placopharynx carinatus*, Cope.
Ohio River.

405. *Moxostoma crassilabre*, Cope.

Little Sandy River (Woolman). Dr. Henshall states that specimens from the Ohio River which he at one time thought to belong to this species proved to be *Placopharynx carinatus*, and he does not think this species (*M. crassilabre*) occurs west of the Alleghany Mountains.

406. Red Horse (*Moxostoma macrolepidotum*, LeS.).

Occurs in most Kentucky streams, large or small. Ohio River, Big Sandy River, Kentucky River, Green River, Cumberland River.

407. White-nose Sucker (*Moxostoma anisurum*, Raf.).

Ohio River, not uncommon (Henshall). Little Sandy River (Woolman). Clear Fork of Cumberland River in Whitley County, one fine large specimen (Jordan).

408. Spotted Sucker (*Minytrema melanops*, Raf.).
Green River (Woolman).
409. Chub Sucker (*Erimyzon sucetta*, Lac.).
Common in many streams. Ohio River, Rockcastle River, Cumberland River, Barnett's Creek in Trigg County.
410. Stone Toter (*Catostomus nigricans*, LeS.).
Common everywhere in the eastern half of the State. Big Sandy River, Kentucky River, Green River, Rockcastle River, Cumberland River, Tennessee River.
411. Common Sucker (*Catostomus teres*, Mitchill).
Very common in eastern Kentucky. Kentucky River and tributaries, Rockcastle River, Cumberland River.
412. Black Sucker (*Cycleptus elongatus*, LeS.).
Ohio River, Cumberland River.
413. Carp, Quill-back (*Ictiobus velifer*, Raf.)
Ohio River, Kentucky River, Big Sandy River, Tennessee River. Obion Creek (Woolman).
414. *Ictiobus difformis*, Cope.
Ohio River, Big Sandy River, Cumberland River, Obion Creek (Woolman).
415. *Ictiobus carpio*, Raf.
Ohio River, common. Rolling Fork, Tradewater River (Woolman).
416. Small-mouthed Buffalo (*Ictiobus bubalus*, Raf.).
Ohio River, common; Green River, Cumberland River, Tennessee River.
417. Mongrel Buffalo (*Ictiobus urus*, Agassiz).
Ohio River at Paducah.
418. Red-mouthed Buffalo (*Ictiobus cyprinella*, C. and V.).
Ohio River at East Cairo and Paducah, common. Indian Creek, Clinton County (Kirsch).

CATFISHES (Family Siluridæ).

419. *Noturus gyrinus*, Mitchill.
Green River, Mayfield Creek, Bayou de Chien
(Woolman).
420. *Noturus eleuthurus*, Jordan.
Green River (Woolman).
421. *Noturus miurus*, Jordan.
Common in many streams. Ohio River, Big
Sandy River, Kentucky River, Green River.
422. Stone Cat (*Noturus flavus*, Raf.).
Licking River (Woolman).
423. Mud Cat, Yellow Cat (*Leptops olivaris*, Raf.).
Common in the larger streams. Ohio River,
Kentucky River, Green River.
424. Bullhead (*Ameiurus melas*, Raf.).
Ohio River, common (Henshall).
425. Bullhead (*Ameiurus nebulosus*, LeS.).
Common throughout the State. Kentucky
River, Green River, Cumberland River. Bayou
de Chien (Woolman).
426. Yellow Cat (*Ameiurus natalis*, LeS.).
Green River, Mayfield Creek (Woolman). Small
tributaries of the Cumberland in Whitley County
(Jordan).
427. Mississippi Cat (*Ameiurus nigricans*, LeS.).
Common in the Ohio River. A specimen ob-
served at East Cairo some years ago weighed one
hundred and twenty pounds. Dr. Jordan states
that he has seen the adult of the Channel Cat (*Ictalurus punctatus*) used on hooks as live bait to catch
this species at Cumberland Falls. Beaver and
Otter Creeks, Wayne County, common (Kirsch).
428. Channel Cat, Blue Cat (*Ictalurus punctatus*, Raf.).

Ohio River, common; Kentucky River, Green River, Cumberland River, Tennessee River.

429. Channel Cat, Blue Cat (*Ictalurus furcatus*, C. and V.).

Common at East Cairo, Paducah, and elsewhere in the Ohio River.

DOG FISH (Family Amiidae).

430. Dog Fish (*Amia calva*, Linn.).

Probably common in the bayous of western Kentucky. Reported thus far only from Bayou de Chien.

GARS (Family Lepisosteidae).

431. Alligator Gar (*Lepisosteus tristoechus*, Bloch and Schneid.)

Ohio River at East Cairo; not rare.

432. Short-nosed Gar (*Lepisosteus platystomus*, Raf.).

Ohio River at East Cairo. Tradewater River, Tennessee River, Bayou de Chien (Woolman).

433. Long-nosed Gar (*Lepisosteus osseus*, Linn.).

Ohio River, Little Sandy River, Kentucky River, Green River, Cumberland River, Tennessee River.

STURGEONS (Family Acipenseridae).

434. Common Sturgeon (*Acipenser rubicundus*, Le S.).

Common at East Cairo and elsewhere in the Ohio River. Cumberland River at Kuttawa (Woolman).

435. Shovel-nosed Sturgeon (*Scaphirynchus platyrhynchus*, Raf.).

Common in the Ohio River at East Cairo and elsewhere.

SHOVEL FISHES (Family Polyodontidæ).

436. Shovel Fish (
- Polyodon spathula*
- , Walbaum).

Ohio River at East Cairo and Paducah, common. Wolf Creek, in Clinton County (Kirsch).

LAMPREYS (Family Petromyzontidæ).

437. Mud Lamprey (
- Ammocætes branchialis*
- , Linn.).

Kentucky (Jordan).

ADDITIONAL SPECIES WHICH MAY OCCUR IN KENTUCKY.

The following list is made up of species which have been found in States adjacent to Kentucky and of such as are known to be generally distributed in the Eastern United States, and hence are likely to occur here. The white-bellied swallow, the geographic turtles, and others, undoubtedly live within our boundaries, but I have no authoritative records to this effect at hand, and prefer to place them for the present under the above heading.

MAMMALS.

1. Weasel (*Putorius nivalis*, Linn.).
2. Little Striped Skunk (*Mephitis putorius*, Linn.).
3. Otter (*Lutra hudsonica*, Lacépède).
4. Big-eared Bat¹ (*Plecotus macrotis*, Le C.).
5. Twilight Bat (*Nycticejus crepuscularis*, Le C.).
6. *Vesperugo georgianus*, F. Cuv.
7. *V. noctivagans*, Le C.
8. Prairie Mole (*Scalops argentatus*, Aud. and Bach.).
9. *Blarina exilipes*, Baird.
10. *B. carolinensis*, Bachman.
11. *B. brevicauda*, Say.

¹Since this list was prepared I have received a specimen of this species from Bowling Green, collected by Miss Sadie F. Price.

12. White-footed Mouse (*Calomys americanus*, Kerr.).
13. Red Mouse (*C. aureolus*, Aud. and Bach.).
14. Rice-field Mouse (*C. palustris*, Harlan).
15. Harvest Mouse (*Ochetodon humilis*, Aud. and Bach.).
16. Meadow Mouse (*Arvicola pennsylvanicus*, Ord.).
17. *A. austerus*, Le C.
18. Pine Mouse (*A. pinetorum*, Le C.).
19. Porcupine (*Erethizon dorsatus*, Linn.).
20. Jumping Mouse (*Zapus hudsonius*, Zimmerman).
21. White-Rabbit (*Lepus americanus*, Erxleben).
22. Water Hare (*L. aquaticus*, Bachman).
23. Marsh Hare (*L. palustris*, Bachman).

BIRDS.

24. Brown-headed Nuthatch (*Sitta pusilla*, Latham).
25. Long-billed Marsh Wren (*Cistothorus palustris*, Wilson).
26. *Helinaia swainsoni*, Aud.
27. White-bellied Swallow (*Tachycineta bicolor*, Vieillot).
28. Painted Bunting (*Passerina ciris*, Linn.).
29. Pine Grosbeak (*Pinicola enucleator*, Linn.).
30. Chuckwill's Widow (*Antrostomus carolinensis*, Gmelin).
31. Prairie Falcon (*Falco mexicanus*, Schlegel).
32. Golden Eagle (*Aquila chrysaetos*, Linn.).
33. American Rough-legged Hawk (*Archibuteo lagopus* var. *sancti-johannis*, Gmelin).
34. Gray Hawk (*Asturina plagiata*, Schlegel).
35. Broad-winged Hawk (*Buteo latissimus*, Wils.).
36. Harlan's Hawk (*B. harlani*, Aud.).
37. Mississippi Kite (*Ictinia mississippiensis*, Wils.).
38. White-tailed Kite (*Elanus leucurus*, Vieillot).

39. Ground Dove (*Columbigallina passerina*, Linn.).
40. Turnstone (*Arenaria interpres*, Linn.).
41. Ring-necked Plover (*Ægialitis semipalmata*, Bonaparte).
42. Black-bellied Plover (*Charadrius squatarola*, Linn.).
43. Eskimo Curlew (*Numenius borealis*, Forst.).
44. Hudsonian Curlew (*N. hudsonicus*, Lath.).
45. Long-billed Curlew (*N. longirostris*, Wils.).
46. Buff-breasted Sandpiper (*Tryngites subruficollis*, Vieillot).
47. Yellow-legs (*Totanus flavipes*, Gmel.).
48. Yellow-shanks (*T. melanoleucus*, Gmel.).
49. Hudsonian Godwit (*Limosa hæmastica*, Linn.).
50. Marbled Godwit (*L. fedoa*, Linn.).
51. Sanderling (*Calidris arenaria*, Linn.).
52. Dunlin (*Tringa alpina* var. *pacifica*, Coues).
53. Baird's Sandpiper (*T. bairdii*, Coues).
54. Pectoral Sandpiper (*T. maculata*, Vieillot).
55. Purple Sandpiper (*T. maritima*, Brunn.).
56. Robin Snipe (*T. canutus*, Linn.).
57. Long-billed Dowitcher (*Macrorhamphus scolopaceus*, Say.).
58. Black-necked Stilt (*Himantopus mexicanus*, Müll.).
59. American Avocet (*Recurvirostra americana*, Gmel.).
60. Northern Phalarope (*Phalaropus lobatus*, Linn.).
61. Black Rail (*Porzana jamaicensis*, Gmel.).
62. Yellow-crowned Night Heron (*Nycticorax violaceus*, Linn.).
63. Louisiana Heron (*Ardea tricolor*, Müll.).
64. Reddish Egret (*A. rufescens*, Gmel.).
65. Little Blue Heron (*A. cærulea*, Linn.).
66. Least Bittern (*Botaurus exilis*, Gmel.).
67. White Ibis (*Gaura alba*, Linn.).
68. Roseate Spoonbill (*Ajaja ajaja*, Linn.).

69. Whistling Swan (*Olor columbianus*, Ord).
70. Ruddy Duck (*Erismatura rubida*, Wils.).
71. Surf Scoter (*Oidemia perspicillata*, Linn.).
72. White-winged Scoter (*O. deglandi*, Bonaparte).
73. Old Squaw (*Clangula hyemalis*, Linn.).
74. Lesser Scaup Duck (*Athya affinis*, Eyton).
75. Canvas Back (*A. vallisneria*, Wils.)
76. Red-head (*A. americana*, Eyton).
77. Shoveller (*Spatula clypeata*, Linn.).
78. Gadwall (*Anas strepera*, Linn.).
79. Mexican Cormorant (*Phalacrocorax mexicanus*, Brandt.).
80. Double-crested Cormorant (*P. dilophus*, Swainson).
81. Snake Bird (*Anhinga anhinga*, Linn.).
82. Forster's Tern (*Sterna forsteri*, Nutt.).
83. Caspian Tern (*S. tschegrava*, Lepech.).
84. Franklin's Gull (*Larus franklini*, Sw. and Rich.).
85. Ring-billed Gull (*L. delawarensis*, Ord).
86. Horned Grebe (*Colymbus auritus*, Linn.).
87. Red-necked Grebe (*C. holbölli*, Reinhardt).

REPTILES.

88. Painted Turtle (*Chrysemys marginata*, Agassiz).
89. *Pseudemys elegans*, Wied.
90. *P. troosti*, Holbr.
91. *P. hieroglyphica*, Holbr.
92. Geographic Turtle (*Malacoclemmys lesueuri*, Gray).
93. Geographic Turtle (*M. geographicus*, Le S.).
94. *Aromochelys carinatus*, Gray.
95. *A. odoratus*, Latr.
96. Mud Turtle (*Cinosternum pennsylvanicum*, Gmel).
97. Alligator Snapper (*Macroclermys lacertina*, Schweigger).
98. *Aspidonectes ferox*, Penn.

99. *Amyda mutica*, Le S.
100. *Cnemidophorus sexlineatus*, Linn.
101. *Eumeces anthracinus*, Baird.
102. *Eutainia saurita*, Linn.
103. *Nerodia rhombifer*, Hallowell.
104. *N. cyclopium*, Dum. and Bibr.
105. *Regina rigida*, Say.
106. *R. grahami*, Bd. and Gir.
107. *Storeria dekayi*, Holbr.
108. Red-lined Horn Snake (*Hydrops erythrogrammus*, Daudin).
109. Red-bellied Horn Snake (*H. abacurus*, Holbr.).
110. Green Snake (*Cyclophis vernalis*, Harlan).
111. Fox Snake (*Elaphis guttatus*, Linn.).
112. *Ophibolus doliatus*, Linn.
113. *O. elapsoideus*, Holbr.
114. *Cemophora coccinea*, Blumenbach.
115. Ring Snake (*Diadophis punctatus*, Linn.).
116. *Heterodon simus*, Linn.
117. *Haldea striatula*, Linn.
118. *Virginia elegans*, Kenn.
119. *V. valeriæ*, Bd. and Gir.
120. Coral Snake (*Elaps fulvius*, Linn.).
121. Massasauga, Prairie Rattle Snake (*Sistrurus catenatus*, Linn.).

AMPHIBIANS.

122. Pickerel Frog (*Rana palustris*, Le C.).
123. Wood Frog (*R. silvatica*, Le C.).
124. Nebulous Toad (*Engystoma carolinense*, Holbr.).
125. Bell Frog (*Hyla cinerea*, Pennant).
126. Castanet Tree Frog (*H. pickeringi*, Holbr.).
127. *H. squirella*, Daudin.
128. *Desmognathus ochrophæa*, Cope.

129. *D. nigra*, Green.
130. Red Salamander (*Spelerpes ruber*, Latr.).
131. *S. guttolineatus*, Holbr.
132. *S. bilineatus*, Green.
133. *Hemidactylum scutatum*, Schlegel.
134. *Gyrinophilus porphyriticus*, Green.
135. *Ambystoma jeffersonianum*, Green.
136. *A. opacum*, Gravenhorst.
137. *A. talpoideum*, Holbr.
138. Hellbender (*Cryptobranchus alleghaniensis*, Leuckart).
139. Mud Puppy (*Necturus maculatus*, Raf.).
140. Siren (*Siren lacertina*, Linn.).

FISHES.

141. *Etheostoma aurantiacum*, Linn.
142. *E. chlorosoma*, Hay.
143. *Lepomis symmetricus*, Forbes.
144. *Chologaster papilliferus*, Forbes.
145. *Phoxinus flammeus*, Jor. and Gilb.
146. *P. neogæus*, Cope.
147. *P. estor*, Jor. and Brayt.
148. *Hybopsis monachus*, Cope.
149. *Rhinichthys cataractæ*, C. and V.
150. *Phenacobius mirabilis*, Gir.
151. *P. teretulus*, Cope.
152. *Notropis photogenis*, Cope.
153. *N. lirus*, Jordan.
154. *N. scabriceps*, Cope.
155. *N. lutrensis*, Bd. and Gir.
156. *Hybognathus nubila*, Forbes.
157. *Petromyzon concolor*, Kirtland.
158. *P. castaneus*, Gir.

MINERALOGICAL AND GEOLOGICAL NOTES.

No. 7.

EVIDENCES OF SUBSIDENCE AND ELEVATION IN ESSEX COUNTY IN RECENT GEOLOGICAL TIME, AS SHOWN BY FIELD WORK AT THE SEA SHORE.

BY JOHN H. SEARS.

(Curator of Geology and Mineralogy, Peabody Academy of Science, Salem.)

WHILE engaged in other work connected with the geology of the county, I have noted such evidences of the subsidence and elevation of the coast line as came under observation and call attention to them now, hoping to awaken some general interest in this subject.

First. The evidences of subsidence are clearly shown along the entire coast line in many sheltered coves. At Nahant, in the cove between Bass Point and the steamboat landing, covered by six to thirteen feet of water at high tide, may be seen numerous stumps of several species of forest trees. Among those which are well enough preserved to be determined are white pine, swamp or white cedar, hemlock, spruce, ash, oak and maple. The roots of these trees are found in original leaf mould and peat beds, from one to three feet in thickness, which rest upon a very tenacious, slippery, blue clay of unknown depth, the leaf mould and peat beds being covered by

washed sand, and stones of all sizes, in a stratum of varying thickness. There are several other places at Nahant where peat beds are seen at or near low water mark. One in the southwest cove of Crescent beach is quite extensive and contains many logs and stumps of old forest trees; another on the northwest side of Little Nahant is of similar character. Lynn harbor and the marshes of Saugus furnish numerous examples of old peat beds in which large logs of pine and oak lie imbedded below the recent accumulation of marine peat and salt grass roots. At Chelsea beach, a few years ago, some excitement was occasioned by the supposed discovery of a supply of natural gas. No doubt the decay going on in one of these old peat beds and the throwing off of marsh gas caused the disturbance.

On the Beverly shore, between West Beach and Moulton's Misery Island, are many stumps of forest trees which may be seen, when the water is clear and still, at a depth of twelve or fourteen feet at low tide. A piece secured from one of these stumps proved it to be white pine.

In a cove near Chubb's Island, Manchester, at the depth of eleven feet below high water mark, are the remains of an oak stump, which, now divested of the sap wood, is twelve feet in diameter inside the buttresses, representing the tree at its full growth in this region.

In Manchester harbor, inside of the Ram Islands, stumps of white pine and oak are found in the original leaf mould and peat beds covered by washed sand and rocks as at Nahant.

In Kettle cove, Manchester, there is one large oak stump four feet below low water mark.

On Kettle cove beach a good section of the submerged area is visible at low water during the spring tides. Near the old road bed, inside of Crow's Island, the marine peat and salt grass roots are from ten to fourteen inches thick.

Directly under the marine peat is a bed of leaf mould and fresh-water peat, from three to four and one-half feet in thickness, in which are found numerous logs of pine, spruce and white cedar and the branches of the ground yew (*Taxus canadensis*), the last named remaining in its normal prostrate position. Below the peat are large oak stumps standing where the trees grew on glacial drift. While securing a specimen of one of the larger oak roots, scratched pebbles and grooved stones were found with oak roots growing around them in their natural position. From these observations it would appear:—(1) That the ancient oaks grew on the glacial till which became depressed; (2) that a lake formed on this area in which accumulated the peat and leaf mould upon which grew the pine, cedar, spruce and ground yew; that (3) this in turn became submerged and the marine peat and salt grass formed above it; and, lastly, (4) that the seaward slope has become so great that the waves are cutting into and carrying away these earlier formations and thus exposing them to view.

At Lobster cove, Magnolia, are the remains of numerous red cedar stumps. Red cedar stumps are also found at Mingo's beach, some of which are six inches in diameter, only the heart wood remaining. With these are many logs of spruce and hemlock ramified by the borings and containing shells of *Petricola pholidiformis*, a mollusk abundant in the peat and clay at this beach.

A section through the peat shows it to be five and one-half feet thick which, taken together with the fact that the surface of the peat is nine feet below high water mark, gives a total depth of fourteen and one-half feet below high water for the bottom of the peat as seen on the beach. In this peat I have collected hundreds of wings of water beetles and a great many fragments of other insects, which

have been identified by Prof. Samuel Henshaw of the Museum of Comparative Zoölogy.¹ These occur from eighteen inches below the surface of the peat to near the bottom. At two feet below the surface of the peat a large bed of coarse stones and roots of the cow lily (*Nupha advena*) were found, while white pine cones, oak acorns, spruce cones, and roots, logs and stumps of spruce, hemlock, pine and oak were found mixed in great confusion, making the work of removing them very laborious. Immediately below this last deposit occurred numerous stems of a species of grass, probably *Phragmites*. Occasionally these stems and joints, and also the roots, have become silicified, but still retaining the outer cuticle and showing the characteristic stomata of the grasses. Near the bottom the peat thins out into beds of leaves, including those of nearly all of our common trees and shrubs. Small twigs and branches were found well preserved, many of which are as tough and strong as if broken from the living tree to-day. This last named and very interesting deposit yields the greatest abundance of spruce and hemlock cones, beech nuts and the empty burrs, chestnuts, hickory nuts, seeds of the hop hornbeam, nutlets of the burr reed (*Sparganium* sp.) and a few oak acorns, besides the seeds of various sedges, grasses, etc.

Salem harbor furnishes additional evidence of subsidence. Oak stumps are often found in the coves, and on the land of Mr. Charles Metcalf in South Salem, near Forest river, are several oak stumps standing in beds of peat.

¹ Professor Henshaw writes:—"With the exception of four vials labelled 'Nahant,' I have looked over your peat insects. The greater part of the material belongs to the Carabidæ (ground beetles) and Dytiscidæ (water tigers). Of the former there are specimens of the genera *Cychrus*, *Platyrus* and *Pterostichus*. *Ilybius biguttatus*, one of the Dytiscidæ, is the most abundant and characteristic species of the lot as a whole. I have also been able to identify specimens referable to *Gyrinus* and there are at least two species of *Donacia*. I cannot see that the insect remains are any different from what we should find to-day."

I have also observed sunken stumps of forest trees at Long beach, Nahant; Little Nahant; Phillips' and King's beaches in Swampscott; Marblehead beach and on the northern end of West beach, Beverly; while the beaches and marshes of Ipswich, Rowley and beyond, furnish similar deposits.

In 1866 I found an area of submerged forest in the cove southwest of Cape Hedge, Rockport, near the point recently called Briar neck. The stumps, so far as could be determined, were red cedar, pitch pine, maple and birch. Of this station, in his report on the geology of Cape Ann (U. S. Geol. Surv., Vol. ix, p. 568), Professor Shaler says: "These interesting remains lie in a position that appears to me to exclude any other hypothesis than that which assumes that the surface on which they stand has been lowered by a downward movement of the subjacent earth."

Specimens have been collected from the stumps in many of the places referred to above and may be seen in the Essex county geological cabinet of the museum of the Peabody Academy of Science. In this connection the following extract from an article in the "Forum" (June, 1890, p. 448) by Prof. W. J. McGee, entitled "Encroachments of the Sea," is of much interest. "The cautious estimate of the rate at which the New Jersey coast is sinking, made by the official geologist of that state, is two feet per century. Now the mean seaward slope of the coastal plain, including its sub-aërial and submerged portions, is perhaps six feet per mile; so that each century's sinking would give a third of a mile and each year a rod of lowland to the ocean. This is probably the maximum rate for this country." The evidence of geographic outline furnished by "drowned rivers" and half flooded and outlying islands indicates that the land has either been recently submerged or is now sinking.

During the past summer I have made soundings in Salem and Marblehead harbors for the purpose of comparing the depths of the water over certain rocks with those given in the report and on the chart prepared by Dr. Nathaniel Bowditch in 1804 and 1805. In his report Dr. Bowditch states that the summit of Bodin's rock was seven feet below low water on the full and change of the moon, taken from easily recognized compass points on the main land and islands in the harbor. Soundings taken with an iron rod on this spot, the first July 17, 1894, low water 6 A. M., full moon, gave 9 feet of water; again taken August 1, 1894, new moon, low water 5.28 P. M., gave $8\frac{1}{2}$ feet of water at the same spot. These soundings were made with care and are reasonably correct and, in this case, offer evidence of a subsidence in the past ninety years at least of one and one-half feet at this point.

Dr. Bowditch's report gives 5 feet of water, at mean low water, on the summit of Privy ledge, 300 yards outside Orne's Island. August 2, 1894, new moon, low water 5.28 A. M., there was 7 feet of water at this point, indicating a subsidence of 2 feet. There is, however, in all probability a greater amount of erosion at this place than on Bodin's rock in the harbor. Dr. Bowditch reported 6 feet of water on the shoalest portion of Abbot's rock, Salem harbor, while on August 30, 1894, new moon, low water, I found 8 feet. Taken at low water, August 31, 1894, Archer's rock had 8 feet of water; September 1, 1894, Bowditch's ledge had $7\frac{1}{2}$ feet, and September 2, 1894, Cut-throat ledge had 6 feet of water. In Dr. Bowditch's report 6-7 feet of water is given for Archer's rock which is 1 foot less than I find it. He gives for Bowditch's ledge 5-6 feet of water where my soundings gave $7\frac{1}{2}$ feet. On Cut-throat ledge Bowditch gives 4 feet of water, while I found 6 feet at extremely low water.

Assuming these soundings taken the past summer to be even fairly correct there certainly appears to be a considerably greater depth of water on all of these ledges than there was ninety years ago. This also agrees with the estimates of Professor McGee of two feet of subsidence for the century for the entire coast.

The season at which these measurements were taken (Aug. 30, 31, Sept. 1, 2, 1894,) was one of extremely high tides and consequently correspondingly low water, so that the figures used give as fair a comparison as it is possible to make with those of Dr. Bowditch.

Second. The evidences of elevation in recent geologic time along the coast line of the country are exceedingly obscure.

According to previously accepted theories the Quaternary period was one of great and widely extended oscillations of the earth's crust. It was divided into three epochs: I. The Glacial. II. The Champlain. III. The Terrace. During the Glacial epoch, in high latitudes, the land became elevated until the continents were from one to two thousand feet above their present height. The Champlain epoch, on the contrary, was characterized by a downward motion of land surfaces in these same regions, until the sea stood, relatively, from five hundred to one thousand feet above its present level. The Terrace epoch was characterized by the gradual rising of the land until the present conditions of the continents and their climate were attained.

But the study of the submerged forests and the comparison of soundings in our harbors indicate a different story for the later portion of the Terrace epoch, and necessitates a probable modification of the theory, so far as it applies to this region.

In Essex County there are numerous examples of shore

lines, determined by the absence of drift and by water worn ledges, at elevations from fifty to one hundred and fifty feet above the sea. At elevations from twenty-five to one hundred feet above the present sea level, noticeably at Turkey hill and Town hill in Ipswich, Grasshopper plain and at Pipe-stave hill in West Newbury, and also in many places on the Merrimac River at Haverhill and Lawrence, there are numerous areas of sand similar to the beaches of our seacoast at the present time. But as no remains of a marine fauna have as yet been obtained from these so-called inland beaches or from the talus of the cliffs, it is highly improbable that they all belong to the Champlain epoch. It is much more probable, however, that they should chiefly be referred to the Terrace epoch. Prof. J. D. Dana says (Manual of Geology, p. 557): "The height of the upper terraces of river valleys and lakes was largely an effect of the height of the flood and not necessarily of a subsequent change of level of the continent."

In relation to the height of the sea level since the Glacial period, Professor Shaler says in the report previously mentioned (p. 571): "The imperfect evidence which I have succeeded in obtaining on the Cape Ann district serving to show the action of the sea above its present level is limited to 150 feet above the present tide mark." These evidences certainly appear to be capable of two interpretations:—first, action of the waves when the sea was at a greater height; and, second, decay *in situ* of weaker rock surfaces resulting from atmospheric causes. Dykes beyond the reach of the action of the sea at its present level, which have been disintegrated, are taken as evidence that the sea must at some time have been at that level. But there are numerous dykes on Salem Neck at about the same level as those referred to by Professor Shaler, which have decayed

in situ to a depth of fifteen feet or more and from which the disintegrated material can be shovelled out in the form of ordinary sand. It does not seem necessary to account for the areas in higher levels where there is an absence of glacial detritus by comparing them to stations on the coast line where the sea has removed boulders and glacial till, and assume that the sea must therefore have produced similar results at these higher levels.

When the flood waters of the Champlain epoch, which undoubtedly covered nearly all parts of New England, subsided and the land surfaces were elevated in the Terrace epoch, doubtless many of the so-called inland sand beaches and alluvial terraces were produced which are now faintly recognizable in some parts of Essex County.

According to the Powellian theory (Prof. W. J. McGee) the sea bottom, being continually weighted down with the detritus furnished during the Glacial, Champlain and Terrace epochs, must have been depressed. The denuded inland hills and mountains which furnished this detritus that built up the drumlins and kames and the deltas at the mouths of the streams,—the outer lobes of which have been cut away by the inroads of the sea, and which are now seen in the forms of marine marshes and clay beds,—being lightened of their loads, would naturally become elevated. As the whole of Essex County is simply a portion of the general coast line, we must look farther inland for the mountains which have become elevated. The elevation of our county coastline in recent geologic times is thus rendered improbable.

From all observations made, the evidence points to the conclusion that there has been a subsidence of the land surface of this coast region in recent, or, more accurately speaking, in post-terrace times; and that this subsidence is still in progress. The submerged forest growth and

peat beds and the compared soundings in the harbors clearly indicate this.

During the past summer, Lieutenant Ripley, U. S. N., and a corps of assistants, have been surveying Salem harbor in connection with the work of the U. S. Hydrographic Survey. Lieut. Ripley has authorized me to say that the results of his work show a greater depth of water over all the ledges in the harbor than was recorded by Dr. Bowditch in 1804-5, and that the seaward slope in the outer harbor has apparently deepened from one to one and one-half fathoms since that time. This corroboration of my observations is especially gratifying for the reason that I had no knowledge of the work of the survey until these results were obtained.

From the accepted rate of subsidence,—two feet for each century,—and as indicated by my observations here, it is fair to assume that the peat beds stood in their normal position and that the trees, whose remains we find to-day beneath the ocean, were flourishing in their full growth from one thousand to twelve hundred years ago.

GEOLOGICAL AND MINERALOGICAL NOTES.

No. 8.

ON A PRE-GLACIAL SAND PLAIN, PROBABLY OF THE TERTIARY AGE, IN THE CENTRAL PART OF ESSEX COUNTY, MASS.

BY JOHN H. SEARS.

(Curator of Geology and Mineralogy, Peabody Academy of Science, Salem.)

SURROUNDING the drumlins or glacial hills in Ipswich, Rowley and Newbury, can be seen deep beds of stratified, nearly pure quartz sand that dip away at a slight angle from the bases of the hills; they have been considered to indicate ancient elevated sea-beaches. Tracing these sand beds in a westerly direction they develop into a considerable sand plain covering a large part of the Linebrook Parish in the western part of the town of Ipswich and extending to Great Swamp Brook in Rowley, forming the plain known as Rooty Plain. Other large beds are seen in West Newbury, north of J. C. Peabody's hill and across the town line into Georgetown. In this town it forms the plain between Rock and Pentucket ponds and the southwestern part of Groveland, extending across West Boxford and a part of North Andover, largely in the valley occupied by the head waters or source of the Parker river.

In North Andover there are a series of drumlins extending from the northeastern part of the town, in a nearly southerly direction to Marble Ridge Station, that nearly obliterate the sand plain except to the north of Great pond and a portion of the Merrimac River bank; here the

river bends abruptly north-northeast, but following the upward course of the river the sand plain spreads out across the city of Lawrence and the eastern part of South Lawrence and in a southerly direction, following up the valley of the Shawsheen river to Haggett's Pond and extending into Middlesex county. By consulting the geological map of Essex County it will be seen by following this course that this sand plain, in pre-glacial times, must have been continuous and have occupied the larger part of the central portion of Essex County.

The drumlins of Prospect Hill in Rowley, Jewett's, Turkey and Town hills in Ipswich, were apparently deposited on this ancient sand plain, as remnants of it are seen in deep beds to form a nearly complete circle around their bases and the slight dip away from the drumlins is a decided argument in favor of this theory. There are also numerous kames and eskars of stratified sand and gravel that are similarly resting upon the remnants of the sand plain in South Groveland and North Andover. Ipswich Town Hill is an especially characteristic example of a glacial hill or drumlin deposited upon the sand plain. On the northwestern part of the hill near High street, there is a deep section from which the sand is being removed showing the dip of the beds of sand and giving a section well up under the hill nearly to the one hundred foot contour line, and in a northeasterly direction about fifty feet above, there is a good section of the drumlin (opened for gravel) showing the unstratified boulder till. Similar exposures of the sand are seen the whole length of High street, north and south and down East street the length of the hill. Other large exposures of the sand cropping out here under the hill are seen on the northeast and north side of this hill, thus making a nearly complete circle around its base. Turkey Hill is also encircled by this sand but the exposures have not been worked into to the same extent.

In texture this sand is very clean and quite even in size of the grains, all but two tablespoonfuls of nearly two quarts passing through a sixty-mesh-to-the-inch sieve. The quartz grains are from sub-angular to well rounded, in fact almost pearly in form, the feldspar grains are about one in twenty, also well rounded; there are a few plates of muscovite, some of which are one-quarter of an inch in diameter; no hornblende or iron-bearing minerals have been detected. Near the surface the sand is in many places quite deeply discolored by limonite which has undoubtedly come from the drift on the surface. Sand from the sand dunes of Plum Island, Castle Neck or Ipswich Beach, are invariably composed of sharp angular grains of feldspar, magnetite and a little quartz; thus it will be seen that the sand of this sand plain, upon comparison with the wind-blown sand of the sea-beach, is found to be quite unlike in its essential characters.

Upon comparing the sand of the sand plain with the well known tertiary sand on Gay Head and with the Nashaquita Cliffs in Chilmark, Martha's Vineyard, they are found to be identical in general character. From the general trend or direction across the county from Ipswich to the Merrimac River in Lawrence, of the remnants of the sand plain, it is fair to presume that the Merrimac River flowed down this valley in pre-glacial times to the sea, covering a much larger territory than it does at the present time. If the drumlins, kames, eskars and other glacial drift were removed and the surface of our county was restored to the condition that it was previous to the glacial period, quite a large part of the central and northern part of the county would present a nearly level plain surface with the water-courses and streams meandering through it with an occasional Monadnock or high, rocky hill rising out of the plain.

Nov. 1894.

VIEW AT POND BEACH, NANT, SHOWING SUBMERGED WHITE PINE TREE STUMPS. PHOTOGRAPHED BY TOBER, 1911.





VIEW AT MINGO'S BEACH, BEVERLY. PHOTOGRAPHED OCTOBER, 1894.

a. Submerged peat beds, $5\frac{1}{2}$ ft. thick, 9 ft. below high water mark.

b. Logs and stumps of forest trees.

c. Sand and stones covering logs, stumps, etc.



BULLETIN

OF THE

ESSEX INSTITUTE.

VOL. 26. SALEM: APR., MAY, JUNE, 1894. Nos. 4, 5, 6.

ANNUAL MEETING, MAY 21, 1894.

THE annual meeting was held in Plummer Hall, this evening, at 7.45 o'clock, President Edmund B. Willson in the chair.

The reports of the Secretary, Treasurer, Auditor, Librarian and Committee on Library and Publication, were read, accepted and ordered to be placed on file.

The report of the Committee on Nominations was presented by Mr. Gardner M. Jones, and it was

Voted, to proceed to the election of officers for the ensuing year. Messrs. Robinson, Perley and J. G. Morse were appointed by the chair to distribute, collect, assort and count votes.

This committee reported the following list of names as receiving all the ballots (77), and these officers were declared unanimously elected :

PRESIDENT:

EDMUND B. WILLSON.

VICE-PRESIDENTS:

ABNER C. GOODELL, JR.,

EDWARD S. MORSE.

DANIEL B. HAGAR,

ROBERT S. RANTOUL.

SECRETARY:

HENRY M. BROOKS.

TREASURER:

WILLIAM O. CHAPMAN.

AUDITOR:

HENRY M. BATCHELDER.

LIBRARIAN:

CHAS. S. OSGOOD.

COUNCIL:

WILLIAM H. GOVE,

GEO. D. PHIPPEN,

THOMAS F. HUNT,

DAVID PINGREE,

FRANCIS H. LEE,

FREDERIC W. PUTNAM,

RICHARD C. MANNING,

GEORGE M. WHIPPLE,

S. ENDICOTT PEABODY,

ALDEN P. WHITE.

REPORT OF THE SECRETARY.

I suppose it will generally be conceded that the report of a society or corporation is not expected to be very interesting to the hearers.

What inspiration can any one find in the process of preparing a report — the gathering together of a number of dry statistics, which the writer well knows will go into one ear of the listener and out the other.

A railroad report, upon the supposition that you could understand it, is not very entertaining reading, even to a shareholder. Who, for instance, can enjoy the reading of the Atchinson, or the Union Pacific Railroad report? We have a great many reports of societies and corporations presented to the Institute, but they are almost always uncut showing that they have not been read. No wonder

—they belong to the class of literature which Charles Lamb styled “books which are no books.” I hope I shall not be charged with being a cynic or a pessimist if I say that, pretty generally, reports are “as dry as a Monday bun !”

It seems to be expected, however, at the annual meeting of a society like ours, there should be some statement made of the doings, in its various departments. In accordance therefore with this time-honored custom, I will read to you the Secretary’s report for the year ending May 1, 1894.

There have been thirteen meetings of the society held at its rooms the past year, for business and discussion. At these meetings, papers mostly of an informal character, have been offered by the following members: The President, Professor Morse, Mr. Nevins, Dr. Cherrington, Mr. Sears, and Rev. Mr. Latimer; and a paper written by Mrs. Grace A. Oliver, upon “Literature for Children,” was read by Mr. Willson.

Remarks upon these papers were made by the President, Mr. Hunt, Mr. Robinson, Professor Morse, Mr. Bridgman, Dr. Cherrington, Mr. Welch, Mr. Cousins, Mr. Manning and other members.

All who participated in these semi-monthly meetings have spoken quite favorably of them, regarding them as interesting and instructive. The attendance so far has been good, but will, we hope, be larger as the meetings become better understood. They are held in one of our library rooms, and it is designed to have them as social as possible, so that no one need feel afraid to speak, as some might hesitate to do, if we met in a larger place.

The course of free lectures in Plummer Hall was well attended. This course attracts a great many people who probably never attend other lectures. The audience is

always an attentive one, and this has often been noticed and the different speakers have from time to time alluded to it. The society is really doing a good work in this direction. The lectures this year have been by Rev. Geo. D. Latimer, Rev. Dr. Flanders, Col. Henry Stone, Rev. E. P. Farnham, Miss Catherine H. Spence of South Australia, Dr. L. J. Cherrington, Rev. Dr. A. P. Putnam and Ezra D. Hines, Esq.

Two special lectures were delivered in Academy Hall, under the auspices of the Institute, members having been admitted by tickets furnished upon application, by the Secretary. The first was on Oct. 16, by Rev. Wm. Henry Johnson, of Cambridgeport, who spoke upon "University Extension," to an interested audience. Mr. Johnson desired to have a course in Salem upon the subject presented, but there were not enough subscribers to induce him to undertake it. It is hoped that another season those persons who are anxious for such a course will make some efforts to have it succeed.

The second lecture was by Rev. Matthew H. Buckham, D.D., of the Vermont University at Burlington, on Oxford University, with lantern illustrations. This lecture gave pleasure to a good-sized audience.

The Institute and Peabody Academy have entertained the following schools and associations, with special attentions:

On June 6, 1893. The Senior Class of Bradford Academy.

On April 23, 1894. A Class of the Lasell Seminary, Auburndale.

On April 24, 1894. New York State Library School.

May 5. Authors' Guild of New York.

May 10. Senior Class of Bradford Academy.

May 12. Society of Colonial Wars.

The donations to the cabinets, the past year, number 670, from 138 different donors.

The number of visitors to the rooms of the Institute has equalled that of previous years, although an inspection of our register indicates that we had but a very few persons from the West last summer. This is easily accounted for, as all the western people went to Chicago, instead of coming east, as usual. Visitors came generally from New York and New England. We had also many from abroad.

The old meeting house of the First Church seems to be more attractive than many modern churches, judging from the applications for the big key. The record says about 8000 attended there the past year.

The last year has been an especially busy one in all departments. The large collection of books and newspapers, in Plummer Hall, the accumulation of years, have been examined and re-arranged, the papers repaired, where they needed it, and collated; and we have helped kindred societies with some of our duplicates.

The entire collection of relics and curiosities in our cabinets has been cleaned, re-arranged and re-labelled. The re-arrangement was made under the direction of Mr. Arthur R. Stone, whose assistance has been invaluable. Upon the completion of this work, on Monday evening, April 9, the whole building was lighted for the first time, and thrown open to members and their friends, some 300 or more of whom, availed themselves of the opportunity to examine the collections, which was done with evident satisfaction. Light refreshments were served and excellent music furnished by the Adèle Mandolin, Banjo and Guitar Club. Mr. Ross Turner exhibited some fine water colors on this occasion.

The work of preparing and arranging the joint exhibit of the Institute and the Peabody Academy of Science at

the World's Fair was, of itself, a great tax on the time and energy of a number of our members and friends, many of whom contributed besides, very handsomely, to the necessary expenses incurred. The society is greatly indebted to this committee who were instrumental in making our exhibit a success. That it was a decided success, is the testimony of all who saw it.

Since the last report the Secretary has made some progress in the arrangement of the manuscripts and other old papers in the fire-proof room on the first floor. When it is remembered that these pieces of paper are estimated by the hundreds of thousands, it will be readily believed, that it is a vast work to arrange all this mass of letters, deeds, etc., which the society has in its possession. The papers left to the society by Doctor Wheatland are in process of arrangement, by Wm. P. Upham, Esq. They are for the most part of a genealogical character, and probably of great value to the historian or genealogist. What we need in this department is more money. A person qualified for the purpose, could be constantly employed in assorting, arranging and indexing these papers, if we had the means to do it. I fear the importance of this matter is not understood. More and more people, as years go by, are becoming interested in looking up family history and genealogy. We are constantly having applications from individuals all over the country for information relative to their ancestors. So many families came originally from England to Salem, in the early settlement of the country that here is the starting point of their investigations. And now the great interest taken in the "Sons and Daughters of the Revolution" and the "Colonial Dames," etc., is such that we are beset with queries, which require considerable study to answer. In this connection, it gives me pleasure to say that during the coming

year, several ladies connected with the Institute contemplate the formation of a class for the study of our local history. It is well known that many of our people have a good knowledge of English, Grecian, Roman or French history, but have little or no knowledge of the history of our own country and city, never having given much attention to this subject.

The following members have died during the year: Stephen M. Allen, of Boston; George F. Brown, James B. Curwen, James Dugan, Willard Goldthwaite, Wm. H. Simonds, William A. Lander, Oliver Thayer, of Salem; Charles P. Thompson, of Gloucester; also Francis Parkman (an honorary member).

There has recently been quite a revival in membership. Since the last annual meeting we have added 91 names to our list of active members, making the whole number 394.

We ought to have 1000 members, and it is hoped every friend of the society will consider it not only a duty but a privilege to help us in the work of increasing our numbers. Professor Morse has spoken of the great number of members, of some of the scientific and literary societies in European cities, some of them numbering from 5,000 to 10,000 members, with a very much larger assessment than we have. Those societies are consequently enabled to do a very important work. It is true they are located in places of a larger population than ours but the population of the County of Essex, of which we are the centre, is large enough to furnish us with a greatly increased membership, to say the least.

I repeat what I have said before, that no society like ours can long be in a flourishing condition, without the encouragement of the young. We want more young men and young women to join us and become interested in the work of the society, and we believe a large number will

do so, as soon as they realize the advantages of belonging to such an institution.

I have said so much in former reports of the great need of increased accommodation for the Library and Cabinets, and that matter is, I believe, so well understood by most of our members, it is hardly necessary for me at this time, to say more. We are constantly hoping that something will turn up, sooner or later, to meet the demands in these departments.

When we consider the comprehensive and inclusive character of the Institute, we feel that we may well pride ourselves in the recollection that we number among our members persons of every religious name—members of all political parties—of the various charitable and fraternal societies—Free Masons, Odd Fellows, Improved Red Men and various other kinds of men and—women. Here are no factitious distinctions. The four pillars which uphold us are History, Science, Literature and Art.

Which is respectfully submitted,

HENRY M. BROOKS,

Secretary.

REPORT OF THE LIBRARIAN.

The additions to the library for the year (May, 1893 to May, 1894) have been as follows:

By Donation.

Folios,	79
Quartos,	199
Octavos,	2,078
Twelvemos,	936
Sixteenmos,	377
Twentyfourmos,	223
Total of bound volumes,	3,892
Pamphlets and serials,	14,313
Total of donations,	18,205

By Exchange.

Folios,	1
Quartos,	22
Octavos,	126
Twelvemos,	1
<hr/>	
Total of bound volumes,	150
Pamphlets and serials,	1,461
<hr/>	
Total of exchanges,	1,611

By Purchase.

Folios,	2
Octavos,	12
Twelvemos,	7
<hr/>	
Total of bound volumes,	21
Pamphlets and serials,	602
<hr/>	
Total of purchases,	623
Total of donations,	18,205
Total of exchanges,	1,611
Total of purchases,	623
<hr/>	
Total of additions,	20,439

Of the total number of pamphlets and serials 7,572 were pamphlets and 8,202 were serials.

The donations to the library for the year have been received from two hundred and thirty individuals and one hundred and twelve societies and governmental departments. The exchanges from eleven individuals and two hundred and twenty-one societies and incorporated institutions, of which one hundred and twenty-seven are foreign; also from editors and publishers.

The largest donations have been 628 volumes and 3427 pamphlets, the larger part of the latter being magazines of early dates, from Hon. Caleb Foote; 155 botanical books from Mr. John Robinson, and 109 miscellaneous works together with 600 pamphlets from the estate of Samuel P. Andrews.

The librarian has little to add to these statistics. A quiet and uneventful year leaves little to be said in a report. Some considerable time has been spent in an examination of the library with a view to making it more accessible to users. The files of newspapers have been arranged and a list made of missing numbers. In order to make room for our ever-increasing number of books it has been found necessary to remove some of those which are rarely consulted to quarters outside the library building. The necessity for this is to be regretted and we are looking hopefully forward to the time when an addition to our funds will enable us to build a stack room in the rear of our present building. We also trust that we may be able at no distant day to make a catalogue of the library and thus greatly increase its usefulness.

With all our drawbacks the library is consulted very frequently and we have reason to believe is of great use to students who are pursuing special lines of study and research.

Our library does not aim to be a popular one in the sense of furnishing the current literature of the day. This is left to, and is abundantly supplied by the Public Library. But we do aim to make it as complete as possible in certain directions and believe it to be a most valuable library for reference and consultation. Students and investigators are always welcome to the rooms and all the advice and assistance possible is given them in the prosecution of their researches.

The public appreciate more and more as the years go by the good work that the Institute is doing in their midst. Let us hope that this appreciation may before long take some substantial form which will enable the Institute to increase its sphere of usefulness.

CHAS. S. OSGOOD,
Librarian.

TREASURER'S REPORT.

Condensed from Treasurer's Report presented May 21,
1894.

RECEIPTS.

Balance from last year's account,		\$378 37
Assessment of members,	\$929 00	
Sales of publications,	315 48	
Income from invested funds,	3,423 87	
" " other sources,	<u>1,326 54</u>	
		\$5,994 89
Interest and contribution to be funded,		44 58
		<u>\$6,417 84</u>

EXPENDITURES.

Salaries of secretary, assistant librarians and janitor,	\$2,141 00	
Cost of books, periodicals and binding,	339 02	
" " publications and printing,	669 51	
" " fuel,	150 00	
" " gas and water,	82 47	
" " interest on note,	150 00	
" " labor in the building,	403 15	
" " Athenæum (our proportion of expenses,)	237 36	
" " express, postage and miscellaneous,	350 35	
" " annuities,	610 00	
" " Columbian exhibition committee,	650 00	
" " repairs,	39 39	
" " lecture expenses,	<u>42 04</u>	
		\$5,864 29
Interest and contribution funded,		44 58
Balance of cash on hand,		508 97
		<u>\$6,417 84</u>

COLUMBIAN EXHIBITION FUND.

Cash received from all sources,		\$3,773 09
Cash expended,	\$3,762 31	
Balance of cash on hand,	<u>10 78</u>	
		\$3,773 90

INVESTMENT OF FUNDS.

Invested for income,	71,762 33	
Essex Institute Building and Ship Rock,	<u>28,470 69</u>	
		\$100,233 02

Respectfully submitted,
W. O. CHAPMAN, *Treasurer.*

Salem, May 19, 1894.

Examined and found correct,
GEO. D. PHIPPEN, *Auditor.*

AUDITOR'S REPORT.

The Auditor would respectfully report that he has examined the report of the Treasurer, with all the stocks and securities in hand and finds the account correct.

Showing that the sum of \$28,470.69 is invested in real estate, including the deeds of this building and a small piece of land with Ship Rock ; also \$71,762.33 invested in stocks and bonds, from which income is derived, making a total investment of \$100,233.02.

The running account for the past year has also been examined, including the receipts and expenditures with the vouchers in hand, and find the Treasurer opened his account with a

Balance of Cash on hand,	\$ 378.37
Collected from assessments, and the income of the fund,	6,039.47
Total,	<hr/> \$6,417.84

\$5,908.87 of which has been paid out for the running expenses as detailed by the Treasurer's report, leaving a balance of \$508.97 cash on hand with which to commence the new year, making a total of \$6,417.84 balancing the other side.

Certificates of verification were appended to the two accounts of the Treasurer.

Respectfully submitted,

GEO. D. PHIPPEN, *Auditor*.

SALEM, May 21, 1894.

REPORT OF THE PUBLICATION COMMITTEE.

Since the last annual meeting there have been printed five parts of the Historical Collections, completing Vol.

29, and the first part of Vol. 30; six parts of the Bulletin, completing Vols. 24 and 25. It is hoped that part two of the Historical Collections, Vol. 30, and part two of the Bulletin, Vol. 26, will be ready for distribution immediately after the present meeting. Besides the regular exchanges with home and foreign societies there have been additions to the library by exchange of publications of the Institute to the amount in value of \$150. The amount received by subscription is very little if any in excess of one hundred dollars. The reprints published this year are:

Salem at the World's Columbian Exposition.

Annual Report for 1893.

Dwellings of Boxford, by Sidney Perley.

Vertebrates of Kentucky, by H. Garman.

Tusayan Foot Race, by J. Walter Fewkes.

Geological Notes, No. 6, by J. H. Sears.

Pipa Americana, by G. A. Arnold.

List of Essex County Soldiers in the French War,
etc., by Eben Putnam.

New Edition of First Church pamphlet.

The Building of Essex Bridge.

Biographical Sketch of James R. Newhall, by N. M.
Hawkes.

Probably one of the most important works of a local nature, published by the Essex Institute, is now in the hands of the Heliotype Printing Company, and will come from the press by June 1st. It is the first of a series of Geological Charts of Essex County from the field work of John H. Sears, Curator of Geology in the Peabody Academy of Science.

The lines on which the publications of the Essex Institute should continue are now pretty clearly marked out. It is only a question of financial ability to carry out the work properly. Societies of like character to the Institute

have large publication funds, the income of which is sufficient to defray the annual expense of publishing. A conservative estimate of the amount required for carrying on the ordinary publications of the Institute would be in the neighborhood of \$800 annually. For special publications there should be added from five to six hundred dollars more. The more one is acquainted with the work of the Institute in its publications, the broader is one's view in regard to their value as a factor in the success of the Institute. Having given up to the Peabody Academy of Science the line of special natural history research, it is the duty of the Institute, on its scientific side, to disseminate the information obtained by local students in geology, zoölogy, archæology and ethnology. This with the hearty coöperation of its sister society it is striving to do. On the historical side, it should as far as possible furnish a medium for Essex County historical memoranda. Much could be done in this way if there were funds which could be employed in copying the parish and town records for preservation and publication. The copying of early records of the Town of Beverly would be a very valuable work, and their publication would bring to the treasury some money from neighboring towns. The Committee have on hand material enough to complete volumes of both the Bulletin and Historical Collections, while the Wheatland Memorial Volume is ready for the press as soon as there is money enough to publish it in the style and with the photogravure illustration which is desired.

LECTURES AND MEETINGS.

Monday, Oct. 16, 1893.—A special lecture under the auspices of the society, by Rev. William Henry Johnson of Cambridgeport, was delivered in Academy Hall

this evening at 8 o'clock; subject, "University Extension." The president introduced the speaker with appropriate remarks. This lecture was of great interest to teachers and there was a large audience present. It was introductory to a course which Mr. Johnson hoped to have in Salem.

Monday, Nov. 20, 1893.—A special lecture was given this evening at 8 o'clock in Academy Hall, by Rev. Matthew H. Buckham, D.D., of Vermont University, Burlington, Vt. The subject was "Oxford University," and was illustrated by excellent views of buildings and scenes in the University city, with the aid of the stereopticon. It was interesting, and the hall well filled. Mr. Willson, the president of the society, made some introductory remarks.

Monday, Jan. 8, 1894.—Rev. George D. Latimer of this city, lectured this evening in Plummer Hall—the first lecture of this season in the free course; subject, "Social Settlements." The paper was a scholarly and exhaustive description of the institutions of the sort in London and Chicago. The Toynbee hall in the very lowest precinct of the Whitechapel district in London was fully described; and the Hull house in Chicago, in one of the lowest parts of that city was spoken of, and an extended account given of it. As it had been visited by the speaker, his statements with regard to it were from personal observation. The speaker said that the "Social Settlement" was not a panacea but a leaven. It is not so much for those who have sunk to the very lowest depths of crime and misery, as for the ambitious poor; not at all for the idle, but for the man who wishes to elevate his condition. It must be on social grounds to be effective.

Monday, Jan. 15, 1894.—Regular meeting in library room. *Voted*, that the secretary be authorized to fill in and sign the blank from the Lexington Historical Society in reference to Fast Day, viz. :—to abolish the same and petition the Legislature to make the 19th of April, a legal holiday; also voted to authorize the Secretary to send thanks to every one who loaned articles for the Institute's exhibit at the World's Fair in Chicago.

Rev. Mr. Willson read a paper written by Mrs. Grace A. Oliver, on "Literature for Children," which was of an important and interesting character, and was subsequently printed in full in the columns of the *Salem Observer*. This paper was discussed by several of the members who were present.

Monday, Jan. 22, 1894. Col. Henry Stone, of South Boston, lectured in Plummer Hall; subject, "General Grant." The lecturer said :—There are no more stirring or thrilling examples before the American public to-day than the four great generals of the late war: Grant, Sherman, Sheridan and Thomas. I knew them all, personally and well. Of the last three I have already spoken to you; and I now would speak concerning the first and greatest of them all—General Ulysses S. Grant. I knew him well, and can speak of him from my heart." Colonel Stone then proceeded to trace the history of the great General from boyhood, up through early manhood; his wonderful war successes and his political and social career.

Monday, Jan. 29, 1894.—Miss Catharine H. Spence, of South Australia, lectured this evening in Plummer Hall on "Reformed Representation." The lecturer began by saying that although Australia was a small country, and was first settled as a penal station for British convicts, it

had taught the whole world many valuable lessons in reform. It was in that country that the "Australian ballot" system originated.

She spoke of the plan of distributing poor children among families of industrious people to be brought up, instead of placing them in institutions. She claimed that this system did away with crime and pauperism to a large extent. All the railroads and telegraphs in her country were under control of the government, by which the people were benefited with low rates, the same as the postal service here.

The speaker explained a system of voting by which the majority and minority were both represented, and said this system would do away with the present political machines and rings.

Monday, Feb. 12, 1894.—Rev. A. P. Putnam, D.D., of Concord, lectured in Plummer Hall; subject, "Recollections of noted persons, at home and abroad." The long array of distinguished men he had known, eminent in civic, military, scientific and social life, for the past fifty years, attested the extensive acquaintance of the speaker. He gave many characteristic anecdotes of Webster, Choate, Garrison, Phillips, Sumner and others of similar eloquence and power. When he spoke of Lincoln, Grant, Adams, Garfield and a few others, and particularly of the acts, which made them great, the enthusiasm of the speaker was imparted to the listeners. In describing his visit to Rome, he spoke of William W. Story, Harriet Hosmer, Joseph Ropes and others he saw there, and alluded to a cherished art specimen given to him by Mr. Ropes at the time. (Mr. Ropes was in the audience, and at the close of the lecture, advanced to the rostrum, where cordial greetings were exchanged between Doctor Putnam and him-

self.) A high tribute was paid to the late Abiel Abbot Low of New York and to several others who have been intimately connected with Salem by birth or residence.

Monday, Feb. 19, 1894.—Regular meeting this evening in the library room. Rev. E. B. Willson read an interesting paper upon the "Covenant of the First Church in Salem in 1629." The paper showed careful preparation and exhaustive research, and at its conclusion a discussion was participated in by A. C. Goodell, jr., John Robinson, W. L. Welch and others. Mr. Willson went over the matter which was discussed at great length many years ago by the late Dr. S. M. Worcester and Judge Daniel A. White, as to whether the covenant of 1629 and 1636 were identical. The point, it was (well) said, was not of vital importance, but interesting (to theologians).

Monday, Feb. 26, 1894.—Rev. George T. Flanders, D.D., of Rockport, lectured in Plummer Hall; subject, "The Seven Stars; a Study of Early Mythology." The lecturer pictured in glowing language the beliefs of the ancients about man upon the earth, more particularly his first habitations and surroundings; drawing illustrations from the views held by the Chinese and other of the older nations upon the subject.

Monday, March 5, 1894.—Regular meeting of the society in the library room. Dr. Leroy J. Cherrington read a paper on "The Electric Theory of Pain." It was a carefully prepared address written for a popular medical article. Pain was regarded as a morbid condition of some bodily part. The working of pain in the system was explained. The general and excessive use of "pain killers" was deprecated, and the lecturer gave an account of his theory for relieving pain, etc. Followed by discussion.

Monday, March 12, 1894.—Rev. E. P. Farnham lectured in Plummer Hall, on "The Kindergarten." The President, in introducing the lecturer, spoke of the fact that two Salem ladies, the daughters of the late Dr. Nathaniel Peabody, were among the very first in this country to be interested in the kindergarten movement, which had been introduced by Horace Mann, Secretary of the Massachusetts Board of Education, upon his return from Europe (Mrs. Mann and Miss E. P. Peabody.)

Mr. Farnham, in giving the history of the movement, pointed out the difference between the kindergarten training received by young children nowadays, and the former methods of instruction. In the first, pleasure is mingled with the studies, while by the old way it was nothing but grinding, hard work.

Monday, March 19, 1894.—Regular meeting in the library room at 8 o'clock this evening. Rev. George D. Latimer read an instructive paper on "Municipal Government." After referring to the government of some of the leading American cities, upon which he made some criticisms, the lecturer spoke of Birmingham and Berlin as remarkable for good city governments. He referred to our own city affairs and thought there could be some improvement. The paper was discussed by Mr. Hunt, Mr. Gove, Dr. Cherrington, Mr. Welch and Mr. Robinson.

Monday, March 26, 1894.—Dr. L. J. Cherrington lectured in Plummer Hall; subject, "The Human Workshop." The lecturer told in an entertaining and explanatory way of the wonderful workshop placed in every human being. He said that man had been likened to a machine, but he went further and declared that in every man was a complete machine shop. He explained the

evolution of the human workshop, which he declared, had its superintendent, its head, and its various departments. For the purpose of his lecture he divided the human system into three parts, the vital, physical and mental, and explained his assertions by several drawings or charts placed upon a screen. The lecture showed much study in its preparation and much ingenuity in its presentation by diagrams placed upon the screen.

Monday, April 2, 1894.—Regular meeting this evening in library room.

Mr. Gardner M. Jones spoke of a large and brilliant meteor he had seen on his way to the meeting at 7.27. His point of observation was opposite 24 Federal street. Its course was northwest through an arc of about 90 degrees, from nearly due south to nearly due west. Elevation—from about 45 degrees at first appearance to about 30 degrees at disappearance. Brightness—like a large rocket, apparently less than 150 feet distant. No explosion or sound was heard. Speed—that of a rocket soon after it begins its descent.

Prof. E. S. Morse gave a most interesting talk on "Left-handedness." He said that to a certain extent it was not peculiar to man but was observed in animals of high or low degree. Certain peculiarities of left-handed people were shown and the speaker said that the right side of the brain was heavier in a left-handed person, and the left side in a right-handed person. Professor Morse gave some interesting examples upon the blackboard of the power of writing with both hands. He said that about two per cent. of mankind are left-handed. Persons who are left-handed can by practice learn to use their right hand, and so can right-handed people learn to use their left hand, but they can never acquire the same dexterity with both

hands. Speaking of the so-called science of palmistry, he said the Japanese had a similar science, only everything there meant about the opposite from what it does among English-speaking people, showing that there cannot be anything in it.

A Geological Map prepared by John H. Sears, as the result of five or six years' labor, was exhibited. It is to be published by the Institute. It is said to be as perfect a geological map as was ever prepared, of any section of the country. Mr. Sears was present and explained some of its features.

Monday, April 16, 1894.—Winfield S. Nevins of Salem, gave an informal talk on Worlds' Fairs that have been held previously to that of last year. The first one was in Paris in 1844. The next in London in 1851; it was for this fair that the Crystal Palace was built, a building which was subsequently sold to private parties and enlarged, the final cost having been more than \$7,500,000, or a million dollars more than all the buildings put together in Jackson Park, Chicago. The third fair was in New York in 1853, and was a failure financially. The fourth in Paris in 1855. The fifth in London in 1862. Paris had another fair in 1867. Vienna, the seventh fair in 1873, a financial failure, but which proved of great benefit otherwise. The Centennial Exhibition in Philadelphia in 1876 came next. The ninth fair at Paris in 1878. In 1889 was held the great Exhibition in Paris, visited by 28,150,000 people or 600,000 more than visited the Chicago exhibition. The Art exhibition at this fair far surpassed anything the world has ever seen, both in quantity and quality. The "Hall of Industry" covered 27 acres and Machinery Hall 15 acres.

Monday, April 23, 1884.—Ezra D. Hines, Esq., of

Danvers, gave the closing lecture in the "free course" this evening in Plummer Hall; subject, "An Historic Highway." Mr. Hines gave an interesting account of the old road leading from Ipswich to Boston. It was probably an old Indian trail that was laid out as a road prior to 1634. Henry F. Waters of Salem, a few years ago, discovered a map in the British Museum, that describes this road. The map was from the celebrated Hans Sloan collection and was labelled, "Map of Massachusetts in New England." On this map the road or path was traced as clearly as though it was a new print. It ran through Medford, Malden, Revere, Saugus, across Saugus river, Lynn, Peabody, Danvers, North Beverly, along the shore of Wenham Lake to "Agawam" (now Ipswich). There can be no doubt as to the age of the map, as the word Agawam shows that it must have been made before 1634, for in that year the name Agawam was changed to Ipswich. Mr. Hines also spoke of the traditions concerning the old highway; its noted inns, and of the distinguished persons who had travelled over it—Gov. Winthrop, Nathaniel Saltonstall, and many others.

Monday, April 30, 1894.—Meeting this evening in the library rooms. Prof. Edward S. Morse spoke interestingly, as usual, upon some new methods of printing in colors. First, describing with chalk illustrations, the common mode of steel and copper engraving and printing, lithographs and wood cuts, and then showing by drawings and specimens the old and new way of color printing.

Monday, May 7, 1894.—Regular meeting of the Society this evening in the library rooms.

John H. Sears, of the Peabody Academy of Science, read some extracts and made some observations upon an

article of his now in process of printing entitled, "Evidences of subsidence and elevation in Essex County in recent geologic time as shown by field work at the seashore." He spoke particularly of this appearance at Nahant in the cove between Bass Point and the steamboat landing.

Prof. E. S. Morse exhibited additional photographs, etc., showing the work of the new process of color printing.

NECROLOGY OF MEMBERS.

STEPHEN M. ALLEN, son of Isaac and Betsey (Gilman) Allen, was born in Burton, now Albany, N. H., April 15, 1819; elected a member of the Essex Institute, Feb. 27, 1874, and died in Charlottesville, Va., Jan. 19, 1894.

GEORGE F. BROWN, son of Samuel and Mary (Smith) Brown, was born in Salem, June 18, 1811; elected a member of the Essex Institute, Aug. 2, 1848, and died in Salem, June 11, 1893.

JAMES P. COOK, son of John and Mary (Patfield) Cook, was born in Salem, Nov. 12, 1820, elected a member of the Essex Institute, July 27, 1865, and died in Salem, Oct. 23, 1892.

JAMES B. CURWEN, son of Samuel and Priscilla (Barr) Curwen, was born in Salem, Nov. 20, 1818; elected a member of the Essex County Natural History Society, June 18, 1845, and died in Salem, Mar. 23, 1894.

JAMES DUGAN, son of Bernard and Mary (Moran) Dugan, was born in Ireland in 1835; elected a member of the Essex Institute, Feb. 6, 1888, and died in Salem, June 8, 1893.

WILLARD GOLDTHWAITE, son of Willard and Dolly (Johnson) Goldthwaite, was born in Weston, May 1,

1820; elected a member of the Essex Institute, July 6, 1864, and died in Salem, Sept. 1, 1893.

WILLIAM A. LANDER, son of William and Mary (Jenks) Lander, was born in Salem, May 8, 1816; elected a member of the Essex County Natural History Society, Mar. 12, 1846, and died in Salem, June 26, 1893.

WILLIAM H. SIMONDS, son of William H. and Julia (Goldsmith) Simonds, was born in Salem, Dec. 3, 1843; elected a member of the Essex Institute, Feb. 7, 1876, and died in Salem, Oct. 29, 1893.

OLIVER THAYER, son of Stephen and Rebecca (Oliver) Thayer, was born in Salem, Mar. 12, 1798; elected a member of the Essex County Natural History Society, Sept. 2, 1846, and died in Salem, June 1, 1893.

CHARLES P. THOMPSON, son of Frederick M. and Susanna (Cheesman) Thompson, was born in Braintree, July 30, 1827; elected a member of the Essex Institute, Feb. 21, 1876, and died in Gloucester, Jan. 19, 1894.

Donations or exchanges have been received from the following sources:

	Vol.	Pam.
Abbott, Samuel A. B., Boston,	1	
Adams, Charles F., Boston,	2	
Adelaide, Royal Society of South Australia,		4
Albany (N. Y.) Institute,	1	
Albany, New York State Library,	4	5
Allen, J. A., New York, N. Y.,		2
Allen, O. P., Palmer,		2
Almy, Mrs. James F.,		4
Alnwick, Berwickshire Naturalists' Club,		2
Altenecker, Thomas, and Sons, Philadelphia, Pa.,		1
Alvord, Henry C., South Weymouth,		1
American Association for the Advancement of Science,		1
Amherst College,		5

Amherst, Massachusetts Agricultural College, . . .		23
Amiens, Société Linnéenne du Nord de la France, . .		12
Andover Theological Seminary,		1
Andrews, Caroline,		9
Andrews, Samuel P., Estate of,	119	600
Andrews, William, Hull, Eng.,		1
Appleton, Francis H., Lynnfield,		1
Appleton, William S., Boston,	1	
Appleton, Wisconsin State Board of Health, . . .	2	
Association of Medical Officers of American Institutions for Idiotic and Feeble-minded Persons, . . .		1
Austin, F. C., Manufacturing Company, Chicago, Ill., .		2
Averille, Arthur A.,	1	
Bailey, Joseph T., Philadelphia, Pa.,	1	
Balch, Thomas W., Philadelphia, Pa.,	2	
Baltimore, Md., Johns Hopkins University, . . .		10
Baltimore, Maryland Historical Society,		4
Baltimore, Md., Peabody Institute,		1
Bamberg, Naturforschende Gesellschaft,		1
Banks, Charles E., Portland, Me.,		1
Banks, James L., New York, N. Y.,		1
Banta, Theodore M., New York, N. Y.,	1	
Basel, Naturforschende Gesellschaft,		2
Batavia, K. N. Vereeniging in Nederlandsch-Indie, .		1
Batchelder, Henry M.,	2	52
Beals, W. H., Chicago, Ill.,		38
Belfast Naturalists' Field Club,		1
Berkeley, University of California,		12
Berlin, Gesellschaft Naturforschende Freunde, . .		1
Berlin, K. Preussischer Akademie der Wissenschaften,		9
Berlin, Verein zur Beförderung des Gartenbaues, . .		24
Bern, Naturforschende Gesellschaft,		1
Biddle, Henry D., Philadelphia, Pa.,	2	
Blinn, H. C., E. Canterbury, N. H.,		24
Bologna, R. Accademia delle Scienze,		2
Bonn, Naturhistorischer Verein,		2
Bordeaux, L'Académie Nationale des Sciences, Belles- Lettres et Arts,		1
Boston, American Congregational Association, . .		1
Boston, Appalachian Mountain Club,		6
Boston Art Club,		2
Boston Board of Health,		12
Boston, Children's Hospital,		1
Boston, City of,	4	

Boston City Auditor,	1	
Boston City Hospital,	1	1
Boston City Registrar,	1	
Boston, Colonial Society of Massachusetts,		1
Boston, Handel and Haydn Society,	1	
Boston, Hemenway South-western Archæological Expedition,		3
Boston, Industrial Aid Society for Prevention of Pauperism,		1
Boston, Massachusetts Bureau of Statistics of Labor,	2	
Boston, Massachusetts Charitable Mechanic Association,		2
Boston, Massachusetts Historical Society,	3	7
Boston, Massachusetts Horticultural Society,		1
Boston, Massachusetts Institute of Technology,		4
Boston, Massachusetts Medical Society,	1	1
Boston, Massachusetts School for the Feeble-minded,		1
Boston, Massachusetts Society of Colonial Wars,	1	
Boston, Massachusetts Society for Promoting Agriculture,		1
Boston, Massachusetts State Board of Agriculture,	2	12
Boston, Massachusetts State Board of Health,	1	55
Boston Museum of Fine Arts,		1
Boston, National Association of Wool Manufacturers,	1	
Boston, New England Conference of Educational Workers,		1
Boston, New England Historic Genealogical Society,		5
Boston Public Library,		7
Boston Society of Natural History,		3
Boston, Trustees of Public Reservations of Massachusetts,		1
Boston, Trustees of State Almshouse and State Farm,		2
Boston, Winchester Home Corporation for Aged Women,		1
Boston, Woman's Relief Corps, Department of Massachusetts,	1	
Bostonian Society,		1
Bradlee, Rev. Caleb D., Boston,	1	
Braunschweig, Deutsche Gesellschaft für Anthropologie, Ethnologie und Urgeschichte,		2
Braunschweig, Verein für Naturwissenschaften,		1
Bremen, Naturwissenschaftlicher Verein,		2
Brigham, Clifford, Newspaper.		
Brighton and Sussex Natural History and Philosophical Society,		1
Bristol Naturalists' Society,		2

Brooklyn, N. Y., Long Island Historical Society, . . .	1	
Brooks, Henry M.,	3	3
Brooks, Mrs. Henry M., Newspapers,		35
Brooks, J. Hobart, Roxbury,		1
Brooks, Margarette W., Circulars, Maps,	1	10
Brown, Alfred B.,		4
Browne, Edward I., Boston,		1
Brünn, Naturforschender Verein,		2
Brunswick, Me., Bowdoin College,		4
Bruxelles, Académie Royale des Sciences, Lettres et Belles-Arts,	3	8
Bruxelles, Société Belge de Microscopie,		5
Bruxelles, Société Malacologique de Belgique,		17
Buckham, Rev. John W., Newspapers,		2
Buenos Aires, Sociedad Científica Argentina,		4
Buffalo (N. Y.) Historical Society,		1
Buffalo (N. Y.) Library,		1
Caen, Académie Nationale des Sciences, Arts et Belles- Lettres,		2
Calcutta, Geological Survey of India,		4
Calcutta, Indian Museum,		3
Cambridge, Harvard University,	1	4
Cambridge, Museum of Comparative Zoölogy,		13
Cambridge, Peabody Museum of Archæology and Eth- nology,		1
Cambridge Philosophical Society,		64
Campbell, John A., Trenton, N. J.,		1
Carpenter, Rev. C. C., Andover,		2
Casey, James C.,	1	
Chamberlain, James A., Boston,		
. Newspapers and Circulars,	7	91
Champaign, Illinois State Laboratory of Natural History,	1	
Chapel Hill, N. C., Elisha Mitchell Scientific Society,		1
Chapman, F. M., New York, N. Y.,		1
Chapman, William O.,		2
Chever, Edward E., San Francisco, Cal.,		3
Chicago (Ill.) Board of Trade,	2	
Chicago (Ill.) Historical Society,		3
Chicago (Ill.) Public Library,		1
Chicago, Ill., Sunset Club,	1	
Chicago, Ill., University of,		10
Childs, George W., Philadelphia, Pa.,		1
Christiania, Norwegian North Atlantic Expedition,		2
Cilley, J. P., Rockland, Me.,	1	4

Cincinnati, Historical and Philosophical Society of Ohio,		1
Cincinnati, Ohio Mechanics' Institute,		1
Cincinnati (O.) Public Library,		2
Cincinnati (O.) Society of Natural History,		3
Clarke, Rev. F. G., Plymouth, N. H.,	1	
Clarke, Helen F.,	3	6
Clement, Mrs. C. H.,	7	
Cleveland, Misses M. S. and L. H.,	2	
Cleveland, O., Western Reserve Historical Society,	5	1
Cogswell, William,	24	
Cole, Frank T., Columbus, O.,	1	
College Hill, Tufts College,		11
Columbus, Ohio State Archæological and Historical Society,		1
Columbus, Ohio State Board of Agriculture,		12
Conant, W. P.,	6	6
Converse, Parker L., Woburn,	1	
Cope, Gilbert, West Chester, Pa.,	1	
Copenhagen, Académie Royale des Sciences et des Lettres de Denmark,		5
Cousins, Frank,	5	
Crane, Albert, Stamford, Ct.,	1	
Crane, John C., West Millbury,		1
Creamer, George C., Hamilton,		5
Curtis, Chester B., New Castle, N. H.,		1
Curwen, George R.,		3
Dall, Caroline H., Washington, D. C.,	1	
Daniels, Mrs. C. H.,		
Danvers Historical Society,		1
Danvers, Peabody Institute,		1
Darmstadt, Verein für Erdkunde,		1
Davenport (Ia.) Academy of Natural Sciences,		1
Daves, Edward G., Baltimore, Md.,		3
Davis, Andrew Mc F., Cambridge,		9
Dayton, W. Hardy,	1	13
Deacon, Edward, Bridgeport, Ct.,	1	
Deane, Mrs. Mary G., Fall River,	1	
Dedham Historical Society,		5
Des Moines, Iowa Geological Survey,		2
Detroit (Mich.) Public Library,		1
District of Columbia, Joint Executive Committee of Citizens' Association of,		1
Dodge, Charles C.,		
Dodge, R. E., Cambridge,		15
		1

Dow, George F., Topsfield,	2	
Dresden, Naturwissenschaftliche Gesellschaft "Isis," .	2	
Dresden, Verein für Erdkunde,	3	
Dublin, Royal Irish Academy,	8	
Eaton, John D., San Francisco, Cal., . Newspaper.		
Edes, Henry H., Charlestown,	6	
Edinburgh Geological Society,	1	
Edinburgh Royal Society,	3	
Emden, Naturforschende Gesellschaft,	1	
Emery, John S., Boston,	2	
Emilio, Luis F., New York, N. Y.,	1	
Emmerton, E. A.,	4	
Erfurt, K. Akademie Gemeinütziger Wissenschaften, .	1	
Everett, William, Quincy,	1	
Exeter, N. H., Phillips Exeter Academy,	1	
Fairhaven, Millicent Library,	2	
Falmouth, Royal Cornwall Polytechnic Society, . .	1	
Felt, John,	86	
Fewkes, J. Walter, Boston,	2	
Firenze, Biblioteca Nazionale Centrale,	26	
Firenze, Societa Entomologica Italiana,	6	
Flint, Albert S., Madison, Wis.,	1	
Folsom, A. A., Brookline,	1	
Foote, Caleb,	628	3427
Foster, Charles A., Topsfield,	1	
Foster, Joseph, Portsmouth, N. H.,	1	
Frankfurt-a-M., Senckenbergische Naturforschende Ge- sellschaft,	3	
Frear, William, State College, Pa.,	10	
Freiburg, Naturforschende Gesellschaft,	3	
French, A. D. Weld, Boston,	1	
Gauss, John D. H.,	5	
Genève, Société de Physique et d'Histoire Naturelle, .	1	
Giessen, Oberhessischen Gesellschaft für Natur und Heilkunde,	1	
Glasgow Archæological Society,	2	
Glasgow, Baillie's Institution,	1	
Glasgow, Natural History Society,	1	
Goldthwaite, Mrs. E. H., Newspapers.		
Goodell, Abner C., jr.,	22	
Goodhue, Fannie K.,	94	9
Goodrich, Arthur L.,	2	203
Gorlitz, Naturforschende Gesellschaft,	1	
Göttingen, K. Gesellschaft der Wissenschaften, . .	2	

Gould, John H., Topsfield, Newspapers,		1
Gould, W. H. H., Washington, D. C.,		1
Grand Rapids (Mich.) Public Library,		1
Green, Charles R., Lyndon, Kan.,		2
Green, S. A., Boston,	21	239
Greenwood, Isaac J., New York, N. Y.,		1
Griswold, Mrs. A. W., Belmont,	1	
Guild, Mrs. Mary S. P., North Cambridge,	1	1
Güstrow, Verein der Freunde der Naturgeschichte,		2
Hackett, Frank W., New Castle, N. H.,		1
Halifax, Nova Scotian Institute,		1
Halle, K. L.-C. Deutsche Akademie der Naturforscher,		5
Hally, Rev. P. J.,		4
Harlem, Société Hollandaise des Sciences,		2
Harrisburg, Pennsylvania State Library,	22	3
Hartford, Ct., Board of Trade of,		1
Hartford, Connecticut Historical Society,		1
Hartford, Ct., Trinity College,		1
Hassam, John T., Boston,		1
Hayward, Silvanus, Southbridge,	2	
Hazelton, F. H., Portland, Me.,	1	
Helena (Mont.) Public Library,		5
Herrick, C. L., Granville, O.,		4
Hewes, David, San Francisco, Cal.,	1	
Hill, B. D.,		6
Hill, H. A., Boston,		1
Hill, N. P., Denver, Col.,	1	
Hoar, E. R., Concord,		1
Hoar, George F., Worcester,		2
Hobart, Colony of Tasmania,		3
Hoboken (N. J.) Ferry Company,		1
Hodge, F. W., Washington, D. C.,		1
Houghton, Michigan Mining School,		2
Hubon, Henry G.,		1
Hubon, William P., Newspapers,		1
Humphrey, George P., Rochester, N. Y.,	1	
Hunt, T. F., Newspapers,	22	231
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Iowa City, Iowa State Historical Society,		6
Ithaca, N. Y., Cornell University,		6
Jersey City (N. J.) Free Public Library,		14
Johnson, Catherine, North Andover,	3	
Johnson, Daniel H., New York, N. Y.,		1
Jones, Gardner M., Newspapers,		43

King, Harriet N.,	8	73
King, Horatio C., Brooklyn, N. Y.,		1
Kjöbenhavn, Botanisk Tidsskrift,		2
Kjöbenhavn, K. D. Videnskabernes Selskabs,		3
Kjöbenhavn, Nord Oldkynd og Historie,		3
Konigsberg, Physikalisch-Okonomische Gesellschaft,		1
Konigsberg, Ultertumo Gesellschaft,		2
Ladd, Gardner P., Groveland,		1
Lamson, Frederick, Newspapers,		11
Lancaster Town Library,		1
Lander, Helen D.,	47	
Lander, William A.,	3	4
Lansing, Michigan State Library,	56	17
Lausanne, Société Vaudoise des Sciences Naturelles,		5
Lawrence Free Public Library,		1
Lawrence, University of Kansas,		4
Lee, Francis H., Newspapers,		40
Lee, Mrs. Francis H., Circulars,	51	79
Leeds, Philosophical and Literary Society,		1
Leiden, Nederlandsch Entomologische Verein,		2
Leiden, Rijks-Universiteit,		3
Leipzig, K. S. Gesellschaft der Wissenschaften,		9
LeMans, Société d'Agriculture, Science et Arts de la Sarthe,		2
Lincoln, Nebraska State Historical Society,	1	
Lisboa, Academia Real das Sciencias,		34
Little, William, Newbury,		2
Lodge, Henry C., Nahant,		1
Logan, Walter S., New York, N. Y.,		1
London, Geological Society of,		2
London, Royal Geographical Society,		10
London, Royal Society,		13
London, Zoölogical Society of,		5
London, Entomological Society of Ontario,		14
London, Ont., Hellmuth College,		1
Los Angeles (Cal.) Public Library,		2
Lovett, William H., Beverly, Newspapers.		
Lund, Kongliga Universitetet,		3
Lyon, Académie des Sciences, Belles-Lettres et Arts,		8
Lyon, Société d'Agriculture, d'Histoire Naturelle et des Arts Utiles,		4
Mack, William,	1	56
Madison, Wisconsin State Historical Society,	63	13
Madrid, Observatorio de,	1	

Madrid, Sociedad Española de Historia Natural, . . .		3
Maine, Secretary of the State of,	1	
Manchester Literary and Philosophical Society, . . .		3
Manchester Museum, Owens College,		3
Manning, James,	8	
Manning, Rebecca, . . . Newspapers and Circulars,		12
Manning, Richard C.,		106
Manning, Robert, Newspapers,	17	1556
Marburg, Gesellschaft zur Beförderung der Gesamten Naturwissenschaften,		2
Massachusetts Board of Managers, World's Columbian Exposition,	1	
Massachusetts, Commissioner of Public Records, . .	1	
Massachusetts, Secretary of the Commonwealth of, .	13	1
Meek, Henry M., Newspapers.		
Meriden (Ct.) Scientific Association,		1
Michigan Agricultural College,		6
Milwaukee (Wis.) Public Museum,		1
Minneapolis (Minn.) Public Library,		1
Montreal Natural History Society,		2
Morgan, John T., Washington, D. C.,		1
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Morse, John G., Newspapers and Circulars,		46
Moscou, Société Imperiale des Naturalistes,		4
Moses, Zebina, Washington, D. C.,	1	
Moulton, Augustus F., Portland, Me.,	1	
München, K. B. Akademie der Wissenschaften, . . .		9
München, Bayerische Botanische Gesellschaft, . . .		1
München, Deutsche Gesellschaft für Anthropologie, Ethnologie und Urgeschichte,		7
Munster, Westfälischen Provinzial Verein,		1
Murphy Varnish Company, Boston,		1
Nahant Town Clerk,		1
Napoli, Accademia delle Scienze Fisiche e Matematiche,		6
Narbonne, Mary A.,	5	
Nashville, Tennessee Historical Society,		1
Nashville, Tennessee State Board of Health, . . .		11
Nelson, William, Paterson, N. J.,		3
Nevins, W. S.,	1	52
Newark, New Jersey Historical Society,	5	47
New Haven, Ct., Yale University,		5
Newport, R. I., Redwood Library and Athenæum, . .		1
Newport, Vt., Rutland County Historical Society, . .		1
New York (N. Y.) Academy of Sciences,		3

New York, N. Y., American Geographical Society,		7
New York, N. Y., American Museum of Natural History,		8
New York, N. Y., Astor Library,		1
New York (N. Y.) Central and Hudson River Railroad,		1
New York (N. Y.) Chamber of Commerce,	1	
New York (N. Y.) Genealogical and Biographical Society,		4
New York (N. Y.) Historical Society,	1	
New York, N. Y., Linnæan Society of,		1
New York (N. Y.) Mercantile Library Association,		2
New York (N. Y.) Microscopical Society,		4
New York (N. Y.) Scientific Alliance of,		2
New York, N. Y., Society of the Sons of the Revolution,	1	
New York, N. Y., The Holland Society of,	1	
Nichols, Andrew, jr., Bridgewater, N. H.,		1
Nichols, James B.,		2
Nichols, John H., Newspapers and Plans,	12	38
Nicholson, J. P., Philadelphia, Pa.,		1
Northampton, Smith College,		2
North Andover Town Clerk,		2
Nourse, Dorcas C., Newspapers,		
Noyes, Horatio N., Cleveland, O.,	1	
Nürnberg, Naturhistorische Gesellschaft,		1
Oliver, Mrs. Grace A., Newspapers,		18
Osborne, Arthur D., New Haven, Ct.,		2
Osgood, Frank S., Newburyport,	1	
Ottawa, Geological and Natural History Survey of Canada,		5
Ottawa, Royal Society of Canada,	1	
Ottawa, The Central Experimental Farm,		29
Page, Alfred B., Boston,		1
Paine, Robert T., Boston,		24
Palfray, Charles W., Newspapers and Music,	12	321
Palo Alto, Cal., Leland Stanford Junior University,		1
Paris, Journal de Conchyliologie,		4
Paris, Société d'Anthropologie,		13
Paris, Société des Etudes Historiques,		1
Paris, Société Entomologique de France,		13
Paris, Société Géologique de France,		3
Paris, Société Nationale d'Acclimatation,		25
Parker, Rev. Edwin P., Hartford, Ct.,		1
Parker, Theodore, Worcester,	1	
Payson, Edward H., Newspapers and Maps,	2	42
Peabody Education Fund,		1
Peabody, Peabody Institute,		1

Pearl, Joseph H., Bradford,		15
Peet, Rev. S. D., Good Hope, Ill.,		7
Pennypacker, Samuel W., Philadelphia, Pa.,	1	
Perkins, George A.,	1	6
Perley, M. V. B., Ipswich,		4
Perley, Sidney, Newspapers,		
Philadelphia, Pa., Academy of Natural Sciences,		2
Philadelphia, Pa., American Catholic Historical Society,		3
Philadelphia, Pa., American Philosophical Society,		3
Philadelphia, Pa., City Institute,		1
Philadelphia, Pa., Drexel Institute of Art, Science and Industry, Circulars.		
Philadelphia, Historical Society of Pennsylvania,		4
Philadelphia, Pa., Indian Rights Association, Circulars.		8
Philadelphia, Pa., Library Company of,		2
Philadelphia, Pennsylvania, Academy of Fine Arts,		1
Philadelphia, Pa., Zoölogical Society of,		2
Philbrick, Misses Eliza and Helen, Newspapers,	4	27
Phillips, Stephen H., Newspapers,	1	30
Phillips, Mrs. Stephen H.,		2
Phippen, Nathaniel,	2	
Pillsbury, Parker, Concord, N. H.,		1
Pingree, David, Newspapers,	86	169
Pitman, Adelaide, Music.		
Poole, William F., Chicago, Ill.,	1	
Pope, Albert A., Boston,		1
Porter, Rev. Edward G., Lexington,		1
Portland, Maine Genealogical Society,		2
Portland, Maine Historical Society,	6	11
Portland (Me.) Society of Natural History,		2
Poughkeepsie, N. Y., Vassar College,		16
Prague, K. K., Sternwarte,	1	1
Pratt, Francis G., jr., Boston,	1	
Providence, R. I., Brown University,		1
Providence, Rhode Island Historical Society,		4
Providence (R. I.) Record Commissioners,	3	
Putnam, Eben, Newspapers and Circulars,	4	226
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Rice, Miss M. C., Newspapers,		1
Richardson, Frederick P.,		1
Richmond, Virginia Historical Society,		2
Riga, Naturforschende Verein,		1
Rio de Janeiro, Museu Nacional,		1
Roberts, Misses A. and E. K.,	11	219
Robinson, John, Maps and Portraits,	177	356
Robinson, Mrs. John,	62	
Roblin, Rev. S. H., Boston,	1	
Rochester (N. Y.) Academy of Science,		1
Roma, Biblioteca Nazionale Centrale Vittorio Emanuele,		1
Ropes, Emmerton and Company,	142	12
Ropes, Mary P.,	27	104
Ruggles, H. S., Wakefield,		2
Sacramento, California State Library,	2	
Sacramento, California State Mining Bureau,		1
Sadler, Mrs. Charles J.,	17	17
St. John, Natural History Society of New Brunswick, .		1
St. Louis (Mo.) Academy of Science,		5
St. Louis, Missouri Botanical Garden,	1	
St. Louis (Mo.) Public Library,		1
St. Paul, Minnesota Historical Society,	2	22
St. Pétersbourg, Académie Imperiale des Sciences, .		1
St. Pétersbourg, Jardin Imperiale de Botanique, . .		1
St. Pétersbourg, Société Entomologique de Russie, .		10
Salem Associated Charities,		1
Salem Athenæum,	8	7
Salem Electric Lighting Company,	1	
Salem, First National Bank,	131	485
Salem, Peabody Academy of Science, . Newspapers,	9	79
Salem Public Library,	4	17
Salem Register,	23	59
Salem Savings Bank, . Newspapers and Circulars,	64	295
Salem Water Works,	1	
San Diego, West American Scientist,		40
San Francisco (Cal.) Board of Supervisors,	1	
San Francisco, California Academy of Sciences, . .		3
San Francisco (Cal.) Mercantile Library Association, .		2
San Francisco (Cal.) Technical Society of Pacific Coast,		4
Santiago, Société Scientifique du Chili,		2
Savannah, Georgia Historical Society,		1

Scudder, Samuel H., Cambridge,		1
Sears, John H.,	Circulars.	
Shanghai, China Branch of Royal Asiatic Society,		1
Shirley, George H., Brooklyn, N. Y.,	Newspapers.	
Silsbee, Mrs. William,		2
Silver, Mrs. Peter,		36
Simonds, William H.,		1
Slade, Daniel D., Chestnut Hill,	Newspapers,	3
Smith, Edward A.,	Newspapers,	22 73
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Smith, Sarah E.,	Map,	12
Somerville Overseers of the Poor,		2
South Boston, Perkins Institution and Massachusetts School for the Blind,		2
Spencer, Mrs. Sarah E., Ithaca, N. Y.,		1
Sprague, Henry H., Boston,		1
Springfield City Library Association,		1
Springfield, Illinois State Board of Agriculture,		8
Springfield, Illinois State Board of Health,		1
Springfield, Illinois State Laboratory of Natural His- tory,		2
Springfield, Mo., Drury College,		1
Stavanger Museum,		1
Stickney, G. A. D.,		13 8
Stimpson, T. M.,	Newspapers.	
Stockholm, Entomologiska Föreningen,		2
Stockholm, Institut Royal Geologique,		26
Stockholm, K. Svenska Vetenskaps Akademie,		10 36
Stone, Robert,	Newspapers.	
Sydney, Department of Agriculture of New South Wales,		2
Sydney, Linnean Society of New South Wales,		3
Sydney, Royal Society of New South Wales,		2
Tacoma (Wash.) Academy of Science,		3
Taunton, Old Colony Historical Society,		3
Taunton, Somersetshire Archæological and Natural His- tory Society,		1
Thorpe, Francis N., Philadelphia, Pa.,		1
Tilton, John P.,	Newspapers,	1
Todd, W. C., Atkinson, N. H.,		1 1
Tokio, Imperial University of Japan,		2
Tompkins, Edward, Oakland, Cal.,		1
Topeka, Kansas Academy of Science,		1
Toronto, Canadian Institute,		3

Traill, Horace S.,	1	
Treat, J. Harvey, Lawrence,	1	
Trenton, New Jersey State Library,	2	
Turner, J. Horsfall, Bradford, Eng.,		5
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U. S. Bureau of Education,	3	4
U. S. Bureau of Ethnology,	2	2
U. S. Census Office,		3
U. S. Chief of Engineers,	7	
U. S. Chief of Ordnance,	1	
U. S. Civil Service Commission,	1	
U. S. Coast and Geodetic Survey,	1	5
U. S. Commissioner of Patents,		1
U. S. Department of Agriculture,	3	26
U. S. Department of Interior,	105	21
U. S. Department of State,	4	21
U. S. Director of the Mint,		1
U. S. Fish Commission,	2	
U. S. Geological Survey,	6	13
U. S. Judge-Advocate-General,		1
U. S. Life-Saving Service,	2	
U. S. National Museum,	1	4
U. S. Naval Observatory,	1	
U. S. Patent Office,		54
U. S. Quartermaster-General,	1	
U. S. Surgeon-General,	1	
U. S. War Department,	11	10
U. S. Weather Bureau,		14
Upsal, K. Vetenskaps Societeten,		1
Ward, C. J., Honorary Commissioner for Jamaica,	2	1
Ware, William R., Boston,	1	183
Waring, George E., Jr., Newport, R. I.,		1
Waring, Chapman and Farquhar, Newport, R. I.,		1
Warren, Fiske, Boston,	1	
Washington, D. C., Anthropological Society of,		5
Washington, D. C., Microscopical Publishing Company,		11
Washington, D. C., National Academy of Science,		1
Washington, D. C., Smithsonian Institution,	4	6
Washington, George, Committee of Centennial Celebration of the Inauguration of,	1	
Waterhouse, S., St. Louis, Mo.,		8
Watertown, Historical Society of,		1
Waterville, Me., Colby University,		2

Watson, Caroline A., North Andover,		2
Watson, S. M., Portland, Me.,		2
Webb, Arthur N.,		1
Webb, Mrs. John K.,		1
Weeden, William B.,		1
Welch, William L., Newspapers,	9	125
Welsh, Herbert, Philadelphia, Pa.,		1
Wendell, Barrett, Cambridge,	1	
Wheatland, Elizabeth,		3
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Whipple, George M., Newspapers,		30
Whipple, Prescott, Newspapers and Circulars,	1	66
White, Andrew C., Ithaca, N. Y.,		1
White Plains, N. Y., Westchester County Historical So- cietv,		1
Whitney, Mrs. H. M., North Andover, Newspapers,		26
Wien, K. Akademie der Wissenschaften,	1	13
Wien, K. K. Geologische Reichsanstalt,		14
Wien, K. K. Naturhistorische Hofmuseums,		24
Wien, K. K. Zoologisch-botanisch Gesellschaft,		4
Wien, Verein zur Verbreitung Naturwissenschaftlicher Kenntnisse,		3
Wiesbaden, Nassauischer Verein für Naturkunde,		1
Wilkes-Barré, Pa., Wyoming Historical and Geological Society,		1
Willcomb, Oliver C., Lynn,		1
Willson, Rev. E. B., Newspapers and Circulars,	3	108
Winnipeg, Historical and Scientific Society of Manitoba,		2
Winsor, Justin, Cambridge,		38
Worcester, American Antiquarian Society,		3
Worcester, Clarke University,		2
Worcester, Society of Antiquity,		2
Wright, Frank V., Hamilton, Newspapers and Circulars,		97
Wright, W. H. K., Plymouth, Eng.,		3
Wurzburg, Physikalisch-Medicinische Gesellschaft,		16
Youmans, William J., New York, N. Y.,	2	413
Zurich, Naturforschende Gesellschaft,		4

The following have been received from editors and publishers :

American Journal of Science.	Marblehead Messenger.
American Naturalist.	Musical Record.
Beverly Citizen.	Nation.
Cape Ann Advertiser.	Nature.
Chicago Journal of Commerce.	Open Court.
Danvers Mirror.	Peabody Advertiser.
Georgetown Advocate.	Peabody Press.
Groton Landmark.	Salem Gazette.
Home Market Bulletin.	Salem News.
Iowa Churchman.	Salem Observer.
Lawrence American.	Salem Register.
Le Naturaliste Canadien.	Traveler's Record.
Lynn Item.	Voice.
Lynn Transcript.	Zoologischer Anzeiger.

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REPORT ON THE GEOLOGY OF ESSEX COUNTY, MASSACHUSETTS, TO ACCOMPANY MAP.

BY JOHN H. SEARS.

(Curator of Mineralogy and Geology, Peabody Academy of Science. 1894.)

A COMPLETE account of the geology of even so small an area as that of Essex County could only be given after devoting the time of a long life to the work in the field and laboratory. I do not, therefore, pretend to offer this report as a completed account, but rather as the results of several years' continuous devotion to the study of our rocks; rocks of such a complex character that in many cases their satisfactory determination seems almost hopeless.

In justice to those who have previously investigated the rocks of the county, and to assist future workers in this field, a list of books and papers which have come to my notice, treating more or less fully of the subject, is appended. In making this list I have been greatly aided by the notes of Dr. M. E. Wadsworth on the Mineralogy and Petrography of Boston and Vicinity, published in the Proceedings of the Boston Society of Natural History, vol. XIX, p. 217, 1877. Nearly all that has been published, however, is of a general character, very little being given in detail.

With the exception of the centennial map of the geology of Massachusetts published in the Proceedings of the

Boston Society of Natural History, in 1876, by Prof. W. O. Crosby, and the maps accompanying the ninth annual report the U. S. Geological Survey of a part of Cape Ann, by Prof. N. S. Shaler, 1890, no other attempt, so far as I am aware, has been made to map the bed rock of any portion of the county.

The atlas sheets of the State Topographical Survey, based on the U. S. Topographical Survey, have been used in the construction of the accompanying map and all plotting of the various formations has been done upon the separate sheets in the field, thus giving more accuracy to the work than could otherwise have been possible.

In connection with the map work, at the outset, it was planned to obtain as nearly a complete collection as possible of the minerals and rocks of the county for exhibition in the cabinet of the Peabody Academy of Science. With this in view persistent collecting has been done each year since 1887. Several thousand specimens of the minerals and rocks have thus been obtained from all parts of the county and covering nearly every outcrop. As the work proceeded it soon became evident that a more accurate map of the bed rock was needed than had been made by previous workers, necessitating a very careful study of the contacts, strike, dip and trend of the rock-masses. Owing to the difficulty of obtaining fresh, unaltered specimens of the outcropping rocks constant drilling and blasting have been required to procure good specimens unaffected by the weather. This, together with the care needed to verify and correct the accounts of previous investigators, has made the work exceedingly slow and laborious.

Many days, and even months, have been devoted to the study of rock specimens from one single station, while, later, renewed field work was required to correlate evi-

dence obtained by microscopic and microchemical analyses; and this, often, in cases where the rock at first appeared to be of some familiar sort and its determination once completed satisfactorily.

While mapping the bed rock it was found that notes upon the drainage and watershed of the county could be made at the same time and thus prepare material for a second map. This work is now nearly completed. Work on the glacial phenomena in the county, represented by the drumlins, moraines, stratified and unstratified drift, kames, eskers, smoothed, striated and grooved surfaces on the various outcropping rocks, has been in progress and the material for a third map is thus well under way.

At the end of each year a report of progress has been made to the Trustees of the Peabody Academy of Science, while during the same time several papers have been prepared which have been accepted and published by the Essex Institute. They are as follows:

Geological and Mineralogical Notes: No. 1. On Soda-lite from Salem Neck and Vicinity (Bulletin Essex Institute, Vol. **xxi**, 1889).

Geological and Mineralogical Notes: No. 2. The Stratified Rocks of Essex County (Bulletin Essex Institute, Vol. **xxii**, 1890).

Geological and Mineralogical Notes: No. 3. The Elæolite-Zircon-Syenites and Associated Rocks of Essex County (Bulletin Essex Institute, Vol. **xxiii**, 1891).

Geological and Mineralogical Notes: No. 4. The Extent and Probable Thickness of the Crystalline Cambrian Deposits in Essex County (Bulletin Essex Institute, Vol. **xxiii**, 1891).

Geological and Mineralogical Notes: No. 5. Augite-Syenite, Vom Rath (Bulletin Essex Institute, Vol. **xxiv**, 1892).

Geological and Mineralogical Notes: No. 6. On the Occurrence of Augite and Nepheline-Syenites in Essex County. (Bulletin Essex Institute, Vol. xxv, 1893).

A paper (Bulletin Museum Comp. Zoology, Harvard University, Vol. xvi, No. 9): Keratophyre from Marblehead Neck.

Other papers are in course of preparation on the quartz-augite-diorite; the granitic arkoses of the northern part of Essex County and on the conglomerates and interstratified red slate, limestone and quartzite beds of Middleton, Topsfield and Boxford.

In studying the rocks for the preparation of these papers over one thousand thin sections and slides have been made for microscopical and microchemical tests in determining the minerals composing them. The determinations have all been made at the petrographical laboratory of Harvard University with the kind assistance of Dr. J. E. Wolff.

The classification here employed largely follows that of Professor Rosenbusch of Heidelberg University, as given in "Notes to Accompany a Tabulation of the Igneous Rocks based upon the system of Prof. H. Rosenbusch," by Frank D. Adams, Lecturer McGill University; published in Canadian Record of Science, Dec., 1891.

PLUTONIC ROCKS: HYPIDIOMORPHIC GRANULAR STRUCTURE.

No. 1. Hornblendic-Granitite.

This name was given to the granitic rocks of Cape Ann by Dr. M. E. Wadsworth and is equivalent to the biotite-granitite of Professor Rosenbusch. Under the general type there are several varieties, either coarse or fine grained, and containing little or much biotite. The Peabody and Lynnfield granitites contain little biotite, while in the Gloucester and Rockport granitites there

is much biotite. There are also local variations in color due to inclusion of other minerals in the feldspars. The Pigeon Hill and Lanesville granitites are of a greenish color, while the granite from Wenham and Ipswich is grayish white. In a few areas the quartz is in excess while in others there is little quartz which is of a smoky color. Examples of this are seen in the upper opening of the Rockport Granite Company's quarry at Rockport. Thin sections of this hornblende-granite when studied with the microscope show it to be composed of the following minerals: orthoclase, microcline, microperthite which is composed of simple twinned albite crystals intergrown across the twinning plane of the microcline, hornblende of the green variety, sometimes altered to glaucophane, much quartz and biotite; with biotite, fluorite, garnet, zircons, actinolite and magnetite as accessory minerals in the feldspars. Nearly all of the rocks of this formation show evidence of subjection to a great strain or crushing force, as most of the original minerals have numerous cracks which have been filled with a secondary formation, either biotite or glaucophane.

Minerals in the thin sections from the Cape Ann Granite Company's quarries are as follows: quartz in large patches which is greatly cracked and crushed, orthoclase, microcline, some plagioclase, microperthite, hornblende, a little biotite, some muscovite, large patches of magnetite, some quite large microscopic zircons, epidote and limonite. The feldspars are much decomposed. This section is nearly identical with sections of the same rock from Wenham, Hamilton and Ipswich.

No. 2. Granophyric-Granite; Contact Zone.

This rock formation is quite variable in texture according to its position in the rock-mass. Near the exact con-

tact it is a coarse, friable, reddish-colored rock; at the centre of some of the larger masses it is fine grained and compact, resembling quartz porphyry, while it is often seen, in portions of larger masses, with a distinctly stratified form. This last form is clearly due to flows or streams of the minerals in the magma of which the rock was composed previous to its consolidation. Near Bass Rock, East Gloucester, every variety of this rock-mass can be seen near the contacts of the augite-syenite and the hornblende-granitite. Microscopic investigation of thin sections of this rock shows that it is composed of the following minerals: quartz, orthoclase, augite, hornblende, biotite, colorless garnet, magnetite, iron-pyrite, glaucophane. The orthoclase has intergrowths of albite forming microperthite and these microperthite areas are honey-combed with quartz forming a micropegmatitic mass which, under cross nicols in polarized light, resembles a beautiful mosaic.

No. 3. Augite-Nepheline-Syenite.

This number covers a great variety of forms of this rock-mass which on a map of a greater scale could be subdivided as elæolite-zircon-syenite, mica-syenite, hornblende-syenite, quartz-hornblende-syenite, quartz-augite-syenite and ægerine-syenite; besides pegmatitic masses containing sodalite, ægerine, acmite, ainigmatite, hydronephelinite, zircons and lepidomelane. There are numerous areas in which foliation is developed as in No. 2. For a fuller description of these rocks see Geological and Mineralogical Notes, No. 6, Bulletin of the Essex Institute, Vol. xxv.

No. 4. Hornblende-Diorite.

In part of this area the rock-mass is distinctly an augite-hornblende-diorite. This is particularly well seen at

Marblehead near the old fort, and on Gerry's Island. In Danvers and Beverly there are numerous small porphyritic and pegmatitic masses of this formation. At Putnamville, Danvers, foliation in these rocks has produced a form which has received the distinctive name of amphibolite-gneiss. A technical description of this formation will be found in Geological and Mineralogical Notes, Nos. 3-4, Bulletin of the Essex Institute, Vol. xxiii.

No. 5. Quartz-Augite-Diorite.

This formation has three distinct forms: quartz-augite-diorite, quartz-hornblende-diorite and quartz-augite-mica-diorite. It has its greatest development in Newburyport, Salisbury and Seabrook, and extends in a southwesterly direction through the towns of Georgetown, Boxford, Middleton and Andover. The form quartz-augite-diorite which I have taken as the type is seen in all parts of the area. Thin sections of the rock from Newburyport, at the old quarry opposite Carr's island, and from Salisbury, give the following minerals: urutilized augite with occasional masses of typical augite, hornblende, biotite, plagioclase having the extinction angle of labradorite, some orthoclase and quartz, an abundance of chlorite, considerable calcite of secondary origin, numerous crystals of apatite, fine acicular crystals of rutile, large micro-zircons, iron-pyrites and magnetite.

No. 6. Muscovite-Biotite-Granite.

This is the typical granite of Rosenbusch and only occurs in Essex County in the towns of Andover and North Andover. Thin sections show that it contains the following minerals: orthoclase, microcline, some plagioclase, quartz, muscovite, biotite, hornblende, numerous garnets, rutile in long needleshaped crystals, magnetite and limonite.

No. 7. Granitic-Hypersthene-Diabase (Norite).

Rocks of this type occur at Nahant, but not elsewhere in Essex County. The granitic-hypersthene-diabase, a distinctive type, is the principal rock-mass of Little Nahant and at Nahant, east of the Maolis Garden, while on Bass point this rock is in part an augite-hypersthene-norite. On Pea island and the ledge adjoining it at Nahant it has the panidiomorphic structure of the dyke rocks, interrupted by areas of porphyritic structures of the older effusive rocks.

EFFUSIVE VOLCANIC ROCKS; PORPHYRITIC STRUCTURES,
INCLUDING VOLCANIC FRAGMENTAL ROCKS, TUFFS,
BRECCIA AND AGGLOMERATE.

No. 8. Rhyolites; Quartz-Porphyry.

Under this head are united all of the so-called felsites, banded felsites, porphyry-felsites, breccia-felsites, agglomerate and altered or metamorphosed forms of this rock mass. On Cat island and on Marblehead Neck, south east of the lighthouse, are good exposures of the form called agglomerate or rhyolitic-tufa containing sharp edged fragments of volcanic glass embedded in ashy materials. Much of this glass has been altered to quartz and the ashy material to an earthy chloritic mass, but it has the same general character as specimens from Breakheart hill in Saugus, described by Prof. J. S. Diller in the Bulletin of the Museum of Comparative Zoölogy, Vol. VII, No. 11, p. 168. The entire area covered by these rocks is too small to attempt to indicate the various forms assumed on a map of this scale, but it is intended to prepare a map, in the near future, on a scale large enough to bring out the principal features of all of the varieties of this most interesting formation. Prof. George

H. Williams, in a recent paper on a similar outcrop in the Cumberland Valley proposed the distinctive name of "the ancient volcanic rocks" for this formation.

OLIVINE ROCKS CONTAINING NO FELDSPATHIC CON-
STITUENT.

No. 9. Serpentine-Peridotites.

This formation has its greatest development in the region of Newbury, two of the principal outcrops being in localities popularly known as the Devil's den and the Devil's basin. They are represented on the map by numbers on the outcrops. Since the area was mapped, microscopic studies of thin sections of these rocks have proved the presence of much augite and hornblende with the serpentine surrounding them, and also developed in the cleavage cracks of these minerals, thus proving that the rock-mass was originally an augite-hornblende-picrite-peridotite. The outcrops in Lynnfield, Peabody and Boxford while probably of the same character have not at present been absolutely proved as such. Sections studied thus far are composed of serpentine and magnetite with colorite and other minerals.

No. 10. Biotite-Mica-Peridotite.

This rock-mass appears on the banks of the Skug river in Andover. When studied from thin sections it is seen to be composed of biotite-mica which is bleached to a nearly white color, calcite, talc, serpentine and magnetite surrounding irregular patches of olivine which is rare, some tremolite and a few small masses of augite which is also surrounded by serpentine.

ARCHEAN ROCKS.

No. 11. Hornblende-Granitic-Gneiss.

This rock-mass which has its greatest development in Middleton, Boxford and Georgetown, has the appearance of an ancient rock by being greatly folded and crumpled, by being cut by veins and tongues of diorite and granite rocks and, also, from its position, being in part below the lower cambrian gneisses. Conclusions made from these field evidences indicate that it is one of the oldest rock-masses of the region, and it should be placed in archean time, the equivalent of the Canadian Laurentian period.

No. 12. Porphyritic-Granitic-Gneiss.

This formation occurs in Georgetown, West Newbury and Amesbury. It is much like the last one described, but contains numerous large porphyritic crystals of microcline which are invariably developed across the plane of the stratification of the rock-mass. The whole area has been subjected to great strain by a down throw fault in the river Parker valley between Georgetown and West Newbury. This strain is seen in the large porphyritic crystals, nearly all of them being cracked, bent or broken. For fuller account of these last two gneisses (Nos. 11 and 12) see Bulletin of the Essex Institute, Vol. xxii, Geological and Mineralogical Notes No. 2.

ARKOSE : CONGLOMERATE-GRANITE.

No. 13. Muscovite-Granitic-Gneiss.

During the past season many additional thin sections of the rocks from all over the area where this formation occurs have been studied in the laboratory with the microscope, throwing much light upon this otherwise little

known class of rocks. The conclusion reached is that these rocks are arkoses and belong to a series of more or less crushed granite conglomerates which have been washed and reconsolidated from the decay of the muscovite-biotite-granite of the region, or from some similar rock farther to the north.

SCHISTOSE FOLIATED ROCKS.

No. 14. Amphibolite-Gneiss.

Where this rock-mass occurs in the diorite area it is clearly proved to be a flow structure caused by currents of minerals in the diorite magma. This seems to be especially clear in the Peabody and Danvers regions. The outcrop near Crooked pond in Boxford is entirely surrounded by the archæan gneiss and is probably a remnant of some metamorphosed Cambrian slate. This is also probably the case at Rooty plain in Rowley. The outcrop in Newbury of this rock-mass from its position, interstratified with limestones, slates and gneisses, is of undoubted Lower Cambrian age, a metamorphosed Cambrian slate.

CRYSTALLINE ROCKS STRATIFIED. METAMORPHIC ROCKS OF CLASTIC ORIGIN.

No. 15. Mica-Schist and Sandstone.

These two rock-masses are invariably interstratified and in some places are seen as members of the Lower Cambrian sediments. The schist is undoubtedly a metamorphosed slate.

No. 16. Corderite-Gneiss.

This rock formation is another member of the Cambrian series and is well developed in North Andover and north of Bald Pate hill in Georgetown.

No. 17. Zoicite-Gneiss.

This is still another member of the Cambrian sediments and should in places be called zoicite-epidote-gneiss. It belongs to the series of metamorphosed slates and sandstones.

No. 18. Limestone, Slate, Quartzite and Sandstone.

This formation comprises the interstratified members of the Olenellus Lower Cambrian fossiliferous beds.

No. 19. Conglomerate-Granite. (Arkose.)

This is composed of large pebbles of granite, limestone and mica-schist.

No. 20. Bostonite or Keratophyre.

Bostonite is the name given by Professor Rosenbusch to a series of dyke rocks of the same composition as the keratophyre, which is distinctly a surface flowing lava and not a dyke. Careful investigation has proved that it covers a coarse breccia and other members of the rhyolite and quartz-porphyrries on a nearly level floor gently sloping into Marblehead harbor.

No. 21. Tinguaita Dyke.

This dyke is seen in Manchester cutting the hornblende granitite and augite-nepheline-syenite at Pickard's point. It is the only recorded occurrence of this rock formation in Massachusetts.

HYPIDIOMORPHIC STRUCTURE.

No. 22. Essexite.

This formation is found in numerous outcrops on Salem neck, Winter island, and at Beverly and Marblehead. It is the type of a basic-augite-nepheline rock, quite porphyritic, and of a nearly black color. It is very different

from any of the syenites previously described and was named from the county of Essex, being peculiarly local in its occurrence.

EFFUSIVE VOLCANIC DYKE ROCKS.

No. 23. Quartz-Porphry Dykes.

This number is placed on outcrops of this rock to distinguish a series of narrow quartz-porphry dykes which are of a later age than the quartz-porphry and rhyolite of the ancient volcanic series, inasmuch as these narrow dykes are seen cutting the latter.

No. 24. Arkose: Conglomerate-Granite.

A typical granitic-breccia found at Magnolia on the southwest side of Crescent beach and in Saugus Centre.

No. 25. Diallage-Gabbro: Pyroxene Rocks.

These are massive dykes first noticed by Dr. M. E. Wadsworth.

EFFUSIVE VOLCANIC ROCKS, YOUNGER SERIES.

No. 26. Liparite Dyke.

This is a dyke about seven feet wide cutting the diorite and granite in Throckmorton's cove on the Marblehead side of Forest river. Thin sections show that the ground mass of this rock is composed of a felting of sanidine crystals, enclosing numerous long porphyritic crystals of sanidine; quite large crystals of quartz, surrounded by a fringe of spherulites, and having inclusions of augite and hornblende crystals; blebs of chalcedony, surrounded by a ferruginous feathery mineral, and the whole thickly covered with spherulites.

CRYSTALLINE ROCKS OF CLASTIC ORIGIN.

No. 27. Red-Slate: Jaspelite.

This rock occurs in Saugus Centre, Lynn and Nahant.

It has been classed by authors as one of the felsite series, but in thin sections, studied with the microscope, it is seen to be composed of clastic grains of quartz and feldspar in a ferruginous pasty cement. At Saugus Centre it is interstratified with a conglomerate and is clearly one of the lower members of the Olenellus Cambrian rocks.

No. 28. Andalusite-Schist.

This rock which is seen in Crescent cove, Nahant, at Glenmere, Lynn, and also in Beverly, at the base of Goat hill, is a metamorphosed slate with veins of andalusite developed in the bedding planes.

VEIN ROCKS.

No. 29. Lead, Silver and Copper Ores.

This number only occurs on the map to mark outcrops where I have actually collected specimens of these ores.

As the town boundary lines have been placed upon the map, thus making the location of the various rock-masses comparatively simple, and as the numbers are invariably placed upon the outcrops of the rocks designated, further explanations seem superfluous.

In printing the map a few unimportant errors have crept in and some smaller outcrops are omitted which will be treated in other papers hereafter. The figure 18, indicating limestone, slate and sandstone, placed at the southeast of Glenmere, Lynn, should have been placed between Glenmere and lake Wenuchus and covering the territory to near Brown's pond in Peabody. Near lake Wenuchus may be seen a fine contact of the slate and hornblende-diorite, and west of Mr. Shorey's house, at the foot of Detroit street, there are good contacts showing the hornblende-granitite cutting the old Cambrian slates.

In closing this report I desire to acknowledge my in-

debtedness to Mr. John Robinson, of the Peabody Academy of Science, for his kind assistance and encouragement throughout the work, to the Essex Institute for the generous manner in which my papers and map have been published, and especially to Mr. T. F. Hunt of the Institute's publication committee, and also to Mr. David Pingree for his gift of the petrographical microscope. I feel under great obligations to Dr. J. E. Wolff, instructor in the Petrographical Laboratory at Harvard and to Prof. N. S. Shaler, for their very kind assistance and advice; and I desire to dedicate this map to the Lawrence Scientific School in acknowledgment of this kindness and the friendships formed there while one of its students.

LIST OF PUBLICATIONS.

NOTES ON THE MINERALOGY AND GEOLOGY OF ESSEX
COUNTY, MASS.*Proceedings of the American Academy.*

- Vol. ii, p. 270. Mansfield Coal Formation at Nahant.
* Prof. L. Agassiz.
Vol. iv, p. 353. Granite as a Building Material.
Chief Justice Shaw.
Vol. vi, p. 167. Minerals from Rockport.
C. T. Jackson.

Boston Journal of Philosophy and Arts.

- Vol. i, p. 390. Green Feldspar from Beverly.
J. W. Webster.
Vol. i, p. 599. Green Feldspar and Zircon from Beverly.
J. W. Webster.
Vol. iii, p. 486. Remarks on the Geology of Boston
and vicinity, continued.
J. W. Webster.

American Journal of Science and Arts.

1st series.

- Vol. iii, p. 232. Salem Sienite, Jasper, Amygdaloid,
etc. Rev. E. Cornelius.
- Vol. iii, p. 364. Epidote at Nahant. J. W. Webster.
- Vol. xxii, p. 1. Report on the Geology of Massa-
chusetts. Edward Hitchcock.
- Vol. xxxiv, p. 402. Columbite and Tin Ore at Beverly.
C. U. Shepard.
- Vol. xxxv, p. 192. Green Feldspar and Galena at
Beverly. C. U. Shepard.

2d series.

- Vol. xviii, p. 198. Crystalline Limestones of Eastern
Massachusetts. T. Sterry Hunt.
- Vol. xxix, p. 65. On Sodalite and Elæolite from
Salem. J. P. Kimball.
- Vol. xxxiii, p. 348. On Orthite from Swampscott.
David M. Balch.
- Vol. xlii, p. 73. Danalite, a new Mineral species
from the Granite of Rockport.
J. P. Cook, Jr.
- Vol. xliii, p. 217. On Cryophyllite, a new Mineral
species of the Mica Family with
some associated minerals in the
Granite of Rockport.
J. P. Cook, Jr.
- Vol. xliv, p. 224. On a new Mineral from Rockport.
W. J. Knowlton.
- Vol. xlix, p. 75. On Laurentian Rocks in Eastern
Mass. T. Sterry Hunt.
- Vol. xlix, p. 185. Labradorite Rock on Marblehead
Neck. T. Sterry Hunt.
- Vol. xlix, p. 398. Labradorite Rocks at Marblehead.
T. Sterry Hunt.

3d series.

- Vol. i, pp. 82-182. Notes on Granite rocks.
T. Sterry Hunt.

Proceedings of the Boston Society of Natural History.

- Vol. iii, p. 341. Fossiliferous Strata at Nahant.
Prof. Louis Agassiz.
- Vol. iv, p. 170. Syenite of Nahant. C. T. Jackson.
- Vol. v, p. 24. Boulders at Salem and Danvers.
Chas. Pickering.
- Vol. v, p. 314. Serpentine of Lynnfield.
C. T. Jackson.
- Vol. v, p. 359. Serpentine of Lynnfield.
A. A. Hayes.
- Vol. vi, p. 294. Supposed Meteoric Stone from
Marblehead. C. T. Jackson.
- Vol. xi, p. 27. Glacial beds at Gloucester.
Prof. N. S. Shaler.
- Vol. xii, p. 150. Drift at Salem and Cambridge.
Prof. A. Hyatt.
- Vol. xiv, p. 45. On the Geology of the vicinity of
Boston. T. Sterry Hunt.
- Vol. xiv, p. 91. Drift at Salem. Chas. Pickering.
- Vol. xiv, p. 91. Geology of Swampscott, etc.
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JOHN H. SEARS.

Peabody Academy of Science.

Salem, Sept., 1894.

BULLETIN

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ON THE SO-CALLED BOW-PULLER OF ANTIQUITY.

BY EDWARD S. MORSE.

IN many of the European Museums one finds in the Department of Classical Archæology a curious bronze object included with the Etruscan, Roman, and Greek collections. This object usually bears the name of *Bogenspanner*, *Buespander*, *Tira Archi*, *Tira del Arc*, etc., according to the nationality of the Museum.

An examination of this object convinced me that it was not a bow-stretcher, or arrow-pull. A further study persuaded me that it had nothing whatever to do with the archer's bow. Realizing that a step would be taken if it could be demonstrated that it was not an archer's implement I began the accumulation of material in the form of sketches and other memoranda of these objects from the private collections of C. J. Longman, Esq., of London, Prof. Henry W. Haynes, and of the lamented William

Hammer, Esq., of Copenhagen, and from the unrivalled collection of armor and weapons of Louis Richard Zschille, of Grossenhain, which was exhibited at the Columbian Exposition, and from the Louvre, the British Museum and the Museums of Zurich, Brussels, Antwerp and the University of Pennsylvania.

It seemed with the material at my command that some light might be thrown on the uses of this object, but after a greatly interrupted study of it for over seven years I reluctantly yield the solving of the enigma to others, having got no nearer an explanation of it than when I first began, contented, however, with the conviction that the usual attribution assigned to it has been disproved.

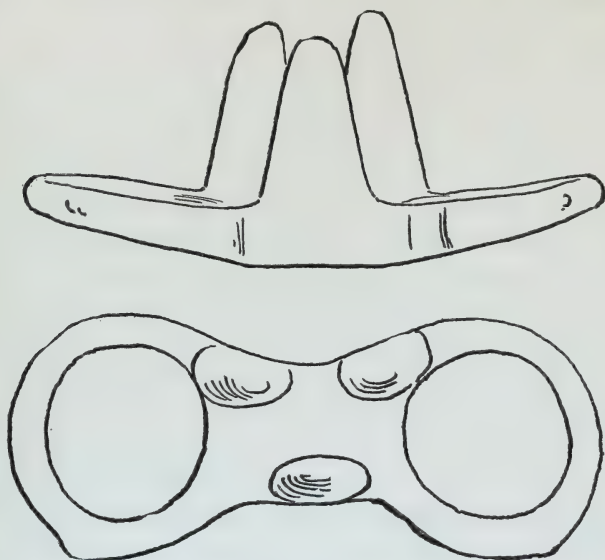
I must here express my indebtedness to Mr. Edward Robinson, Curator of Classical Antiquities of the Boston Museum of Fine Arts, for numerous references to works containing allusions to this object. To Prof. Henry W. Haynes, I am also under obligations for important citations; and to Mr. Ross Turner, for two examples which he purchased in Florence; also to Mr. Dwight Blaney, for a number of sketches of bow-pullers in the Museum of Archæology, at Florence, and in the British Museum.

To the courtesy of Mr. Stuart Culin, Director of the Museum of Archæology, University of Pennsylvania, and to Mrs. Cornelius Stevenson, Curator of the Mediterranean Collections, I am indebted for the privilege of figuring the superb example on Plate I.

As the object under discussion has been almost universally labelled bow-stretcher in museum collections I shall use a similar term bow-puller in referring to it.

The bow-puller is usually of bronze, rarely of iron, roughly cast. (The accompanying figures 1, 2 and 3, in outline, represent the front, top and side views respectively of a plain form of bow-puller; on Plate I are shown in half-tone the front and top views of the plain and the

ornamented form of bow-puller.) It is in the form of two rings springing from a solid centre. The two rings might



FIGS. 1 and 2.

be compared to the frame of a pair of eye-glasses, only in place of the delicate spring connecting the rings, the intervening space is solid metal though less in width than the transverse diameter of the ring (see plan, Fig. 2). This space may be called the body, and from this body spring three spines at right angles to the plane of the rings. It will be observed that the rings are not on a plane but turn slightly upward so that the object rests on the body. This feature is very marked in some specimens though in rare instances the rings are in a plane, and in very rare cases bend slightly

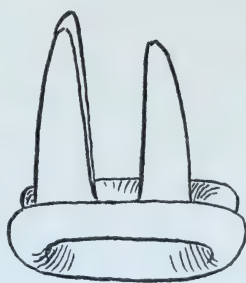


FIG. 3. End View.

downward. The spines are arranged in a triangle, the perpendicular of which is at right angles to the longitudinal axis of the body. It will be seen by the plan that the base of one spine is on one side of the longitudinal axis, while the other two spines are on the opposite side of this axis and parallel to it. It will be observed that when any ornamentation is present (see Plate III), it is always on that side from which the single spine springs; furthermore when an animal's head is part of the ornamentation the head invariably points downward when the object is resting with the spines pointing upward. From these facts it is safe to assume that the object has a front and back, and an above and below. The longitudinal axis should really be the fore and aft axis, but for convenience of description I have indicated the greatest length of the object as the longitudinal one. All embossments, ribs, cross-hatchings, circles, depressions, etc., are on the front side of the object, or on that side from which the single spine springs. On the front sides of the rings, also, inequalities are often found, usually duplicated on both sides. These may be small swellings, strongly marked knobs and in some cases phalli conspicuously modelled. The knobs suggest rudimentary phalli.

There are two leading types of these objects, one in which the rings are slender (see Plate II), the outline when looking down upon it showing only a narrowing between the rings; a section of the outer part of the ring is round, or an oblique oval as in Fig. 1, Plate IV. In this type there is no ornamentation whatever, though the front side of the rings may show slight inequalities as if rudiments had survived of previous embossments. The upward turning of the rings is more marked and the spines are usually shorter than in the other type in which the rings are thick and ponderous (see Plate III), and a section of the outer part of the ring resembles the section of a

cylinder as shown in Fig. 3*a*, Plate III. The front side is conspicuously ornamented with circles, cross lines, vertical ribs, knobs, and in a few cases with the phallic emblem on each side and pointing away from the centre. At the base of the front spine a steer's head is sometimes seen in high relief, or a lion's head with a lion on both sides, stretching toward it. The outline of the object shows strong indentations and the spines are usually heavier and longer. In both types the spines vary greatly in form; the paired spines may be widely separated at their bases, or united nearly to their apices; the bases of the three spines may be close together, or a space of a centimeter or more may separate the front spine from the back spines; the spines may be long and pointed or they may be very short and blunt; they may be round, square or angular in section or elongate oval (Plate IV, Fig. 8), but in the latter case the flattening is parallel to the longitudinal axis of the object. The three spines may be of equal length, or may vary; in some the front spine is the longest, in others the two back spines are longer. The paired spines may also vary, sometimes the left one, sometimes the right one being the longer. While there is no uniformity in the length, thickness or form of the spines, the larger number of bow-pullers have three spines, though they are found rarely with four spines (Plate IV, Fig. 1), sometimes long and tapering and again in the shape of four short knobs (Plate IV, Figs. 2, 3, 4).



FIG. 4.

In this form the knobs may be widely apart or close together (Fig. 4). Furtwängler figures one from Olympia with five spines (Fig. 5), and in the Zschille collection is one with two spines only (Plate II, Fig. 9), these being the paired ones with no trace of a front spine having existed.

While the decoration is generally duplicated on either side, that is, the bilateral symmetry of the object is carried out in the decoration, I have never seen two bow-pullers alike or in pairs.



FIG. 5.

The objects in their extreme length, measured from the outer edges of the rings and the inner edges of the openings across the solid body are remarkably con-

stant. The dimensions are as follows :

Mean of heavy form—length,	71.0 ;	between rings,	19.3
“ “ light “ “	67.8 ;	“ “	20.7

The average deviation from the mean is greater in the light forms and the space between the two rings, or across the body, has a slightly larger average in the light forms.

In the few bow-pullers I have had an opportunity of studying minutely, the signs of wear are such as would be produced by a cord, rope, or leathern strap passing through the rings and under the body as in the accompanying figure (Fig. 6, A B strap). The signs of wear are very marked in some specimens. The outer surface of the back spines also shows marked evidences of wear in some cases.



FIG. 6.

The objects are sometimes found broken and the manner of breaking is of importance. The outer portion of one or both rings is broken away (Fig. 7, also Plate IV, Figs. 5, 6, 7), indicating the direction of the strain to have been outward, and probably downward, as if the strap or cord was used in binding the object to some body, and the method of wear would sustain this proposition. The spines also in rare cases are found broken and it is usually the outer spine which is mutilated in this way. The tip of the front spine is in some cases bent inward. In no case have I seen a specimen with the spines bent outward. The object, whether heavy or light, has been designed for strength.

The bow-puller shown in Fig. 5, Plate II, has an opening in one of the rings; this is probably the result of an imperfection in casting and not intentional. The same may also be true of a round protuberance on the front of one of the rings of a bow-puller (Fig.

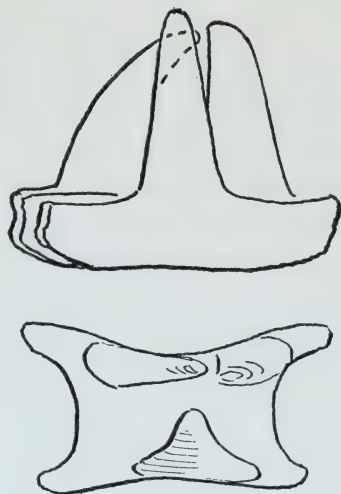


FIG. 7.

6, Plate II). The curious groove seen in the inner edge of the outer part of the ring in Fig. 3, Plate II, is unique so far as I know.

In an object varying so much in weight, number and length of the spines, ornamentation, or absence of it, the features which seem to have an importance in considering their probable use are first and foremost the two rings springing from the solid body and their usual upward

inclination and the uniform length of the object (the average deviation from the mean being very slight), the evidence that the object has a front and back, and an above and below, the spines springing at right angles to the plane of the rings. With these constants, so to speak, might be added the importance of those surfaces showing signs of wear, as well as the bending of the spines and manner of breakage.

The bow-pullers are found associated with Etruscan, Early Roman and Early Greek remains; they belong to pre-classic and early classic times. They have been found in the tombs of warriors. In two examples figured by Strobel, chains with large 8-shaped links are drawn through them (Fig. 10). It was the association of the chain in this way that led Strobel to conceive the object to have been designed for some form of snaffle or curb for horses. Reference to Strobel's memoir will be made further on.

While in nearly every instance this object is labelled in museums bow-stretcher or bow-puller, authorities have not fully accepted this interpretation without question. Gozzadini in his memoir on the ancient Etruscan Cemetery of Marzabotto near Bologna says: "Archæologists have agreed, but I do not know on what foundation, in supposing that certain double rings provided with three points were used by archers by inserting the middle and fore finger in order to stretch the cord. Now this attribution is strengthened by Tommsen, Director of the Museum at Copenhagen, who told Cavedoni that some 'of these implements were found placed together with bronze bows in caves in the northern countries.' They are found in all Egyptian, Etruscan and Roman Museums and they are taken out of Lacustrine stations, and *Torbiere* (Pit graves ?) and they find them again in opening the Necropolis of Marzabotto without, however, that phallic sign

which occurs on others. For the same purpose were possibly three other double rings the peculiarity of which is that they have three small points." Gozzadini figures two of these objects which are reproduced on Plate V, Figs. 20, 21.

Friederichs, in his catalogue of bronzes in the Berlin Museum, protests against the usual interpretation of the use of this object without, however, offering any suggestion as to its possible character. He says, "As a foundation for the common acceptance that the implements here catalogued should have served the purpose of pulling the bow I have been able to find only one observation, namely of Tommsen who has rendered good service in the sphere of northern Archæology. According to his statement these objects have been found together with bows in the caves of northern nations. However, this circumstance is not sufficient to confirm the supposed purpose, all the more as it is absolutely impossible to understand how this implement is to be used; particularly those having five points (for they have been found with three, four and five points) are entirely inexplicable from this point of view. In Naples the implements are exhibited among articles pertaining to harness, but I cannot specify how and where they should have been applied. They have also been explained as weapons for hurling against cavalry, for which purpose, however, the points are partly too broad, partly too thick and stout. Finally I will give the opinion of a technical friend whose explanation is that they are a kind of screw-driver." Friederichs further adds that these implements are of classic as well as of barbaric origin.

As a practical archer my attention was immediately arrested by this object—the first one I ever saw—in the Antiquarian Museum at Zurich. The curator kindly allowed me to examine it, and I was soon convinced that it had

nothing to do with a bow so far as drawing the arrow was concerned. It was important, however, to settle definitely this question. Derived from early classic times it seemed reasonable to believe that, if it were associated with archery in any way, a representation of it would certainly be found on figures of soldiers or hunters in antique bronzes and marbles. A categorical statement of the objects represented in the hands of these ancient figures would show among other implements, utensils, weapons, etc., such as the cestus, discus, strigil, shield, spear, sword, cymbal, pipes and even the bow; and such ornaments as arm-bracelets, clasps, etc., all details of the sandal, and manner of fastening; and yet an examination of hundreds of these figures fails to show any object remotely resembling the bow-puller. An extended examination of the decoration on ancient vases did not reveal any object of this nature. The figures are depicted as holding in their hands various weapons, flowers, tablets, branch of a tree, flask, staff, club, jumping weight, double flute, oil-jug, fillet, helmet and an infinite variety of other objects, yet no evidence of this implement is found either in the hand or upon the person. Wall paintings in Etruscan tombs while showing a variety of weapons do not depict the bow-puller. Surely if this object was associated with man as an implement or was utilized in any way by a soldier, a hunter, or an archer, we ought in some single case to find a trace of it. What more natural than to show the insignia of an archer on the hand, or secured to his person? Yet figures of archers, and fragments of hands in the attitude of drawing the bow have been repeatedly found and no such appliance as the bow-puller is depicted. Its entire absence in these ancient representations is certainly overwhelming proof, if no other evidence were needed, to show that this object has been wrongly named.

I have already shown in my paper on Ancient and Modern Methods of Arrow Release¹ that, as far back as classic times, the European drew the bow with the tips of his two or three fingers. From the fact that the Mediterranean nations have used this release I have termed it the Mediterranean release. A remarkable example of this release has come to light since the publication of that paper in the discovery of the so-called Alexander Sarcophagus, at Sidon, in Phœnicia. Mr. Edward Robinson informs me that this most beautiful specimen of Greek sepulchral art yet brought to light is now in the Museum at Constantinople, to which place it was carried by Hamdy Bey, the Director of Antiquities of the Ottoman Empire. This scholar, in conjunction with M. Theodore Reinach, has published it, and other sarcophagi found at the same time and place, in a sumptuous work entitled *Une Necropole royale à Sidon*. The date of this sarcophagus is probably the latter part of the fourth century B. C. On one side is represented a hunt, in which Greeks and Persians take part, and on the other a battle between the Greeks and Persians. At the time of its discovery the magnificence of its decorations gave rise to the supposition that it was the sarcophagus of Alexander the Great, whence it derived its name; but while this theory is no longer maintained it is still possible that the principal figure in each scene may be a portrait of him, somewhat idealized, as many of his portraits were.

In the battle scene is shown the most perfect Mediterranean release of classic times. A photograph of this sarcophagus was sent to Mr. Robinson shortly after its discovery and from this he has recently had made a sun print enlarged to natural size which may be seen in the gallery of sculpture, Boston Museum of Fine Arts.

The bow-puller certainly had nothing to do with this

¹ Bulletin of the Essex Institute, Vol. XVII, Oct.—Dec., 1885.

method of release. The savage releases which I have termed primary and secondary are out of the question. The only other release which could have occurred in the regions where the bow-pullers are found is the release which I have termed the Mongolian, and this method would have been used by some Mongoloid race such as the Turks, or the modern Persians, who, though not Mongolian, early acquired the Mongolian release, and here the thumb-ring would have appeared. Had the so-called bow-puller been used in the way conjectured we should expect a certain uniformity in that part presumably engaged in pulling the cord of the bow, but we have seen that the spines vary in number from two to five, and in length from two millimeters to sixty. The variation in the space between the spines is equally great, in one case wide enough to admit a rope as big as one's finger, and in another example so constricted that a thread would hardly be admitted. If now we examine the thumb-ring used in the Mongolian release we find the greatest uniformity in its shape, even among widely separated peoples, and even in ancient times, as shown by a bronze thumb-ring dug up near Palmyra, by the distinguished classical archæologist Dr. Felix von Luschan.

I have not been able to find any early references in regard to the bow-puller and do not know on what grounds, or at what time, the name *bogenspanner* was first applied, but one may easily conjecture the origin of its name. In a vague sort of way it was known that the Asiatic archer used a thumb-ring in drawing the bow; little attention, however, seems to have been given to the exact method in which it was used. As an illustration of this vagueness in regard to archery one may find in the art galleries of Europe many pictures, particularly by Italian artists, of the martyrdom of Saint Sebastian. In nearly every case

the archers are armed with the Turkish bow ! Cross-bows are often depicted in illustrating the same subject, a weapon that was not known for hundreds of years after the event. As another illustration I may cite the famous Germanic Museum of National Antiquities at Nuremburg. In its collections is a Turkish thumb-ring, a Turkish bow, and other accessories of a Turkish archer's outfit. A detailed drawing, natural size, is exhibited to illustrate the manner in which the thumb-ring is used, and the drawing shows the ring on the wrong hand and upside down ! Even the curious grooved device which is held in the bow hand to permit the archer to draw the arrow some inches within the bow is directed outward as if to guide the arrow. In a similar way the idea having obtained that the ancient Greeks pulled the arrow in the Asiatic fashion (see Hanzard—*The Book of Archery*), Thorwaldsen in restoring the hands of the figures on the pediments of the temple of Ægina endeavored to represent what he supposed to be the Asiatic method of drawing the bow. As a result he has wrought the fingers in a way utterly impossible for an archer to assume in releasing the arrow, and of course leaving out the thumb-ring or any other appliance of that nature. From this confusion of ideas in regard to the matter it is quite probable that, when the curious bronze implement under discussion was first studied, the two fingers so naturally adjusted themselves in the rings that it was supposed to be an archer's device for drawing the bow, and this error has been transmitted by subsequent writers on the subject.

Caylus in 1757 figures this object in his *Recueil d'Antiquités*. He expresses no opinion in regard to its use, and further adds that no use has been assigned to it. He figures the object upside down as if standing on three legs, the three spines in this instance, being of the same length.

Friederichs has stated that some have conceived it to be a caltrop, and rightly says it could not be of service in this way on account of the bluntness of the spines.

A comparison with the ancient Tribulus (Fig. 8) shows an entirely different device. The Tribulus was a ball of metal from which sprang four sharp spikes so that in whatever manner it was flung upon the ground one spike always pointed upward. In this connection it may be remarked that Furtwängler in his *Olympia*, figures a single flat ring from which spring three sharp spines (Fig 9), and he queries whether this was allied to the bow-puller.



FIG. 8.

It is barely possible, though hardly probable, that this might have been a form of caltrop. We can hardly imagine what Friederichs' technical friend had in mind when he suggested that the bow-puller was a kind of screw-driver, for it seems impossible that any implement for drawing or pulling out any fixed object could remotely resemble the bow-puller.

Pellegrino Strobel under the title *Anelli gemini Problematica* (Bulletin di Paletnologia Italiana xvi, 1888), presents the results of his study of a number of specimens preserved in the Museum at Parma.



FIG. 9.

His material consisted of fourteen bronze ones and two of iron. The larger number of these were three pointed but as the double spines were in some cases united nearly to their tips he regarded them as bicuspid. These, as I have already shown, should be regarded as tricuspid, and in a later paper Strobel so regards them. Of the fifteen specimens described, twelve had three spines, and three had four spines. In two of the implements the front spine was bent inward and was also slightly longer than the paired ones.

In this memoir Strobel advances the idea that the object was designed for a snaffle or nose-band to be used as a curb for horses. He says that in the Iron Age some progress must have been made in the training of horses and in this training a curb or snaffle must have been evolved, and he therefore expresses the belief that this enigmatic object was used for that purpose. He believes that it was held against, or upon the nose of a horse in such a way that the spines could be forcibly pressed against the flesh, the two spines being below, while the longer single spine was above, and hence this side of the object was ornamented. (I have already shown that there is no constancy in the relative length of the spines in the tricuspid ones. In forty-two specimens, for example, the single spine is longer in fourteen, shorter in thirteen, and of the same length as the others in fifteen. In some of them the single spine is only half the length of the other two.) He explains the phallic emblem which is found on some of them to indicate the soundness and virility of the horse in training. In a second paper in the same bulletin (xv, 1889), he had examined sixty specimens of which five were of iron, the rest of bronze. Of these sixty specimens the origin of thirty were known, and in some of these the method of burial and associated objects were also known. In this paper Strobel states that there are three theories in regard to the probable use of this puzzle: First, to assist in drawing the bow; second, for stretching the cord of the cross-bow (which was not used for a thousand years after!); third, to aid in restraining horses not only as a snaffle, but as a curb.

Dr. Charvet, in the Bulletin of the Anthropological Society of Lyons (1889, p. 70), has a communication on this subject which he calls *Gourmet de Répression*. In this paper he adopts the views of Strobel in regarding it as a

snaffle, though he thinks the instrument was worn under the nose instead of above, and he says this opinion is based on a daily experience in training horses by ordinary *caveçon* (curb), which ought not to operate except at the will of the trainer. In Strobel's conception of its use it would always be pressed against the horse's nose whereas

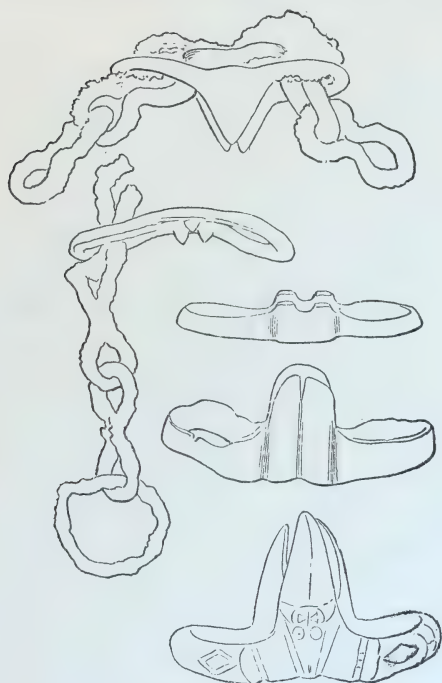


FIG. 10. Reproduced from Strobel's Memoir.

it should be under the chin or throat; the trainer then pulls it with greater or less force at will. Strobel figures two of these instruments with a large eight link chain passing through the rings (see Fig. 10), and Charvet says this chain was simply to hold the implement in place. Charvet further expresses the belief that from this object the curb originated when bits were rigid and not jointed in the

middle. Strobel in reply cites the quadridentate type as being curved to adapt itself to the curve of the horse's nose when pressed down. The rings were big enough to allow the chain to pass through and yet leave room for a rope to be tied to each ring. In his second paper Strobel figures a snaffle of two centuries ago and one used at the

present time. I fail to see any relation between these two forms and the enigma under discussion. Charvet urges that the implement worn in the way suggested by Strobel would wound and ruin the horse. Strobel says that in any case the chain did not press down the implement; the rein or cord which he believes was attached to it was pulled at the will of the trainer. He believes that his first idea of the use of this object is correct, though it might have been used under the nose as suggested by Charvet. Strobel says that no object preceding the bit has been found in pre-historic times. He contends that there must have been an evolution of the bit, and if this object is not a stage in that development then nothing has been discovered to fill the gap. He finally expresses the opinion that all the twin rings were similar in function and that was the controlling of horses. I have quoted the views of these authors at some length as the object certainly suggests an association with harness and possibly with that of a curb or snaffle.

(In Fig. 10 some of Strobel's figures are reproduced half-size.) Opposed to this idea may be properly urged the great variation in the length of the spines. In some we find long, sharp points, in others short, square knobs. Nothing would be effected by forcing such short blunt knobs against a horse's nose either above or below, and as to the long-spined ones it would be impossible to hold the object in place; the object would be tipped or pulled over on its side however it were worn. As to its forming a stage in the evolution of the bit we find the linked bit in Etruscan tombs associated with this object. If this were a curb or snaffle of any kind it would certainly appear on some one of the many ancient bronzes, marbles or vase paintings of horses. Now an extended examination of these various representations has failed to reveal any

object remotely resembling this implement. If it had been used as a curb in the way suggested it would have been, of all objects, the most conspicuous in those examples in which men are represented as leading or holding a rearing horse, and there are many representations of this character. Had it been worn inside the mouth as a bit the elaborate ornamentation seen on some of them would have been useless. The ponderous weight of some compared to the light weight of others would also be against this supposition. For these reasons we cannot accept this interpretation of its use.

Knowing the ingenuity of Mr. Frank Hamilton Cushing, the distinguished ethnologist, in puzzling out enigmas of this nature, I placed in his hands one of these objects for study; he also had access to a very beautiful long-spined specimen in the collections of the Museum of Archæology of the University of Pennsylvania, a figure of which I am permitted to publish through the courtesy of the officers of the museum. In an exceedingly instructive paper on the origin of the bow published in the proceedings of the Anthropological Society of Washington (the same being Mr. Cushing's address as presiding officer of the Anthropological Section of the American Association for the Advancement of Science), Mr. Cushing has advanced a most ingenious idea of the use of the bow-puller by conceiving that it was originally developed from a spear-thrower. Indeed he goes so far as to assert his belief that it was really used functionally for that purpose, and, to support this contention, he gives a graphic figure of an ancient Roman soldier in the attitude of throwing a spear with the aid of this implement. Were all the bow-pullers similar to the two he had in his possession one might be inclined to regard his surmise as having the same degree of probability as the various guesses that have already

been offered. The ancient spear-thrower of the Romans has long been known from numerous figures of it in classical drawings. It was simply a leathern strap—*amentum*—secured to the middle of the spear or javelin to assist in giving force to the act of throwing. The *amentum* is so often figured on ancient vases that the method of spear-throwing is beyond question. The bow-puller shows by its signs of wear no such use as would be indicated by Mr. Cushing's supposition. The single spine, against which the end of the spear is supposed to rest, is, when bent at all, always bent inward and not outward; furthermore the two spines, between which the end of the spear is supposed to pass, are usually too close together to permit the passage of even a narrow spear-butt. In many cases, as we have seen, the two spines are united nearly to their tips (Plate V, Fig. 12); in one instance only the double spines are present (Plate II, Fig. 9); in a considerable number there are four spines in pairs. This attribution of its use, therefore, may be dismissed with the other conjectures.

Other suggestions occur to me as to its probable use, though I confess they have no greater degree of probability than that of the screw-driver conception. The Japanese, and probably the Chinese, are accustomed to use a device of metal for holding down the long pith wicks in the saucer-shaped lamp. This object is in the form of a ring with a single spine rising from one side, or the ring may have a transverse bar from which springs the metal spine. Figures of these two forms are here given (Fig. 11). After this idea occurred to me I became acquainted with Friederichs' catalogue of bronzes in the Berlin Museum already referred to. In cataloguing the specimens of *Bogenspanner* he describes one upon which is a steer's head, flanked by two phalli, and adds parenthetically "a connection that has already been found in the lamps." The

phallus, as we know, was to guard the object against evil influences, and one may find representations of this symbol not only on lamps, and other objects, but even painted on

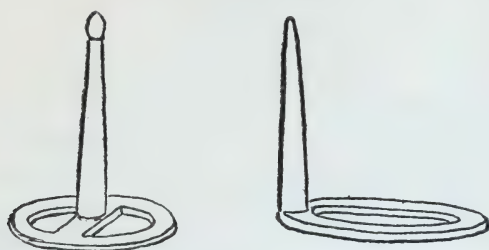


FIG. 11.

the kitchen range as at Pompeii. This remote surmise, however, is not at all weakened by a curious object in

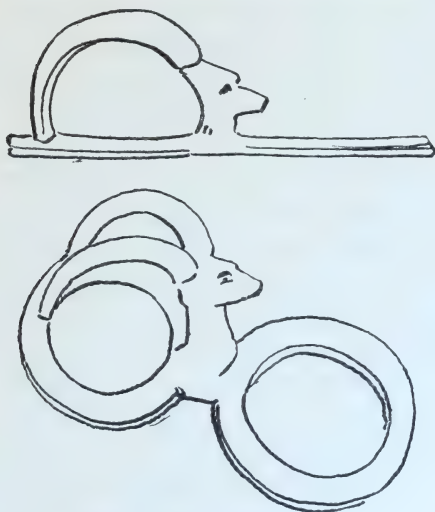


FIG. 12.

the British Museum, for a sketch of which I am indebted to Mr. Dwight Blaney, and which is here produced (Fig. 12). In this a steer's head rises from the body between the two rings, while the two horns curve back and unite with the outer rim of one of the rings. It does not seem possible that this object has any relation to the bow-

puller unless it be a lamp wick-holder. If it is related, then all other attributions of its use are vitiated by this unique

form. If any grounds exist for believing it to be a lamp utensil then the spines might be supposed to assist in holding the wicking material whatever it might be. The upward bending of the rings might be supposed to fit the curving surface of the oil saucer. Roman saucer-lamps are common and would seem to necessitate some device for keeping the wick submerged. The great variety in the objects which are supposed to be bow-pullers, or related to them, suggests the idea that they were not all used for the same purpose. Whatever the first one was designed for it is possible that objects for entirely different purposes were made in imitation of the first form. Thus in our times a paper-weight may be seen in the form of four cannon balls, an inkstand in the form of a mortar, a bronze pen-rest in the shape of a cavalry saddle, or a horseshoe turned up on end (a remarkable Greek vase in the British Museum is beautifully modelled in the form of a horse's hoof) and so on. Thus it may be that some of these objects may have been used as a weight to hold down the lamp wick.¹

It is possible that the long-spined ones were strapped or bound to a horse or man to keep a load from shifting or swinging. This use is suggested on account of their manner of wear and breakage.

A friend of mine has suggested that the object might have been bound to the hand to enable a chariot driver to hold the reins more firmly in driving; a curb, in fact, but held in the hand and not attached to the horse's head. This idea is strengthened by the uniform length of the object, and the upward inclination of the rings corresponding respectively with the width of the palm and its hollowing shape. Nearly all the bow-pullers fit naturally into the palm of the hand; the occasional bending of the spines and

¹ I have already called attention to the evidence of, at least, two distinct types of bow-pullers, not including such forms as those shown in Figs. 10 and 12. With sufficient material these types may be found to run into each other; but with the objects thus far examined the differences seem to hold good.

the points being sometimes broken, the signs of wear on the sides of the spines, and the manner of breaking of the rings just where a strain would come when great force was used, all support the idea. So impressed was Lieut. W — of the United States Navy of the correctness of this supposition that he bound a bow-puller to his hand by means of a handkerchief, and then held a leathern strap so firmly that three men dragged him about the room but could not loosen his hold upon the strap. If this suggestion has any value then one can easily understand why the object has not been revealed in ancient sculpture or painting. The object being grasped in the closed hand would be concealed from view.

It has been suggested that possibly the spines were made to be driven into some object. This could hardly be so, as the openings in the rings were evidently to be left free for the passage of a cord or strap. In this connection, however, it may be remarked that the bronze figurines illustrated in Gozzadini's memoir have spines springing from the feet below, for the purpose of attaching the object to some base of support, and these spines strongly resemble the spines of many of the bow-pullers, in being broad at the base, pointed at the end and strong and clumsy in appearance.

The possibility of the spines being inserted in any object is further negatived by the ornamentation extending along the front spine as in Fig. 3, Plate I, which would not have been added if the spine were intended to penetrate anything. The head shown in high relief on the spines of Fig. 2, Plate III, and Fig. 14, Plate V, would prevent their insertion for the purpose of fixing the object.

In Japan a curious device is used to hold a pot at varying heights above the kitchen fire. These devices are shown in my work on Japanese Homes and their Surroundings (Figs. 173, 175). The device shown in Fig. 173 is

often depicted in old Dutch paintings and is doubtless in use in Holland to-day. In Gozzadini's final memoir on the ancient Etruscan cemetery at Marzabotto, 1870, are figured two bronze pots to which are attached chains (links 8-shaped) terminating in a large circular ring and identical with one of the chains figured by Strobel as passing through a bow-puller, a reproduction of which is given in this paper in Fig. 10.

If the various forms regarded as bow-pullers are for different purposes, and there can be no question that some of them are entirely unrelated, then we may conceive that some of them might have been used for holding the reins. The bow-pullers if representing a single purpose (as Strobel is inclined to believe they do), invalidate by the varying length, character and number of spines, every attribution assigned to them.

As an evidence of the uncertainty in regard to the uses of the bow-puller one may turn to the comprehensive Dictionary of Greek and Roman Antiquities, by Daremberg and Saglio, in course of publication, and he will there find on page 473, under matters pertaining to the bow, a very poor figure of a bow-puller with a brief note of its supposed use, signed by Saglio. Later on under horses' bits, curbs, etc., under the sub-title *Siguette*, page 1336, the figures of Strobel are reproduced and his interpretation of the bow-puller as being a snaffle is indorsed. The article is signed G. Lafaye.

SUMMARY.

1. As a Bow-Puller. It is simply impossible to draw a bow with it, and if a bow-puller it would appear in ancient sculpture and painting.

2. As a Cross-Bow Implement. The cross-bow was unknown to the ancients.

3. As a Caltrop or Tribulus. The spines are too short and blunt in many of them and the long-spined ones would not remain in position ; they would show no signs of wear ; furthermore the Tribulus is known and has no resemblance to this object.

4. As a Screw-Driver. The idea is unthinkable.

5. As a Spear-Thrower. The varying character of the spines and signs of wear are against the idea ; furthermore the amentum used by the ancients for spear-throwing is well known as a leathern strap attached to the middle of the spear.

6. As a Snaffle or Curb. Again the variation in the length of the spines, and the fact that in no case has any device of this nature been represented on a horse's head in ancient sculpture, are sufficient to disprove the idea.

7. As a Bit inside the mouth. The jointed bit was co-existent with it, and the ponderous character of some of the bow-pullers, and the lightness of others, would militate against this conception of its use.

8. As a Lamp Wick Holder. The signs of great wear and its manner of breakage renders this supposition valueless.

9. As an object to prevent a load from slipping. The small tubercles which take the place of long spines in some of them would render it useless for that purpose.

10. As a Curb to hold in the hand for grasping reins or anything else. The great length of the spines in some specimens would preclude its use in that way.

EXPLANATION OF PLATES.

PLATE I.

Natural size.

Figs. 1, 2. Bow-puller. Plain type, front and top view. Collection, author.

Figs. 3, 4. Bow-puller. Ornamented type, front and top views.
Collection, Museum of Archæology, University of
Pennsylvania.

PLATE II.

Plain type. Natural size.

- Fig. 1. Collection, Prof. Henry W. Haynes, Boston.
 " 2. " C. W. Longman, Esq., London. From Perugia.
 " 3. " " " "
 " 4. " E. S. M.
 " 5. " Antiquarian Museum, Zurich.
 " 6. " Louis Richard Zschille.
 " 7. " " " (cast iron).
 " 8. " The late William Hammer, Copenhagen.
 " 9. " Louis Richard Zschille (no trace of front spine).

PLATE III.

Ornamented type. Natural size.

- Fig. 1. Collection, C. W. Longman, Esq., London.
 " 2. " Louis Richard Zschille.
 " 3. " Museum of Archæology, University of Pennsylv-
 ania. a, Section of ring. Rough sketch of
 the one shown on Plate I, Figs. 3, 4.
 " 4. " British Museum.
 " 5. " Louis Richard Zschille.
 " 6. " " " "
 " 7. " " " "

PLATE IV.

Figures natural size.

- Fig. 1. Collection, Louis Richard Zschille.
 " 2. " " " " This section shows the
 form adapted for rope or strap to pass
 through rings and under body in the manner
 already described.
 " 3. " British Museum.
 " 4. " Louis Richard Zschille.
 " 5. " William Hammer.
 " 6. " Prof. Henry W. Haynes.
 " 7. " " " " "

The last three figures are given to show man-
ner of breakage.

- Fig. 8. Sections at base of spines of some of the
bow-pullers already figured.

PLATE V.

The Figures are reproduced half size from rough sketches made through museum cases, etc. The exact dimensions are not known.

- Figs. 1, 2, 3, 4, 5. Collection, Museum Porte de Hal. Brussels.
Fig. 6. " Museum of Archæology, Florence
 (Etruscan).
 Sketch by Mr. Dwight Blaney.
" 7. Collection, British Museum.
 Sketch by Mr. Dwight Blaney.
Figs. 8, 9, 10, 11, 12, 13. Collection, Museum of Archæology, Florence.
 Sketch by Mr. Dwight Blaney.
Fig. 14. From Strobel's Memoir referred to in text.
Figs. 15, 16, 17. From Photographs Etruscan Collection,
 Museum of Archæology, Florence.
" 18, 19. The Louvre. Hasty sketches by E. S. M.
" 20, 21. From Gozzadini's Memoir referred to in
 text.

FIG. 1.



FIG. 2.

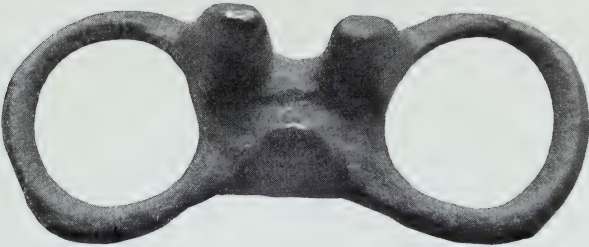
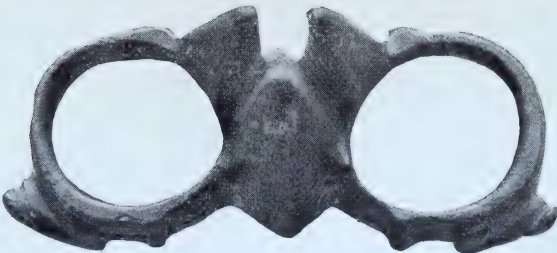


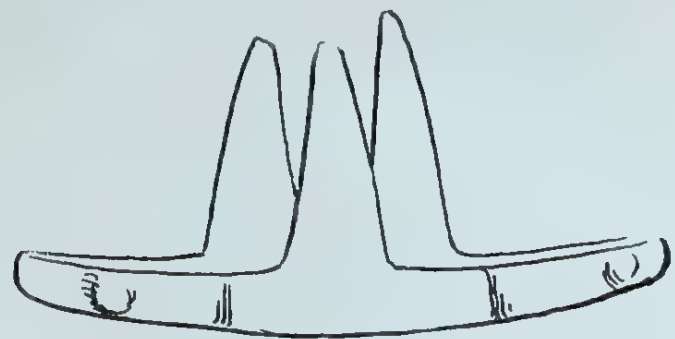
FIG. 3.



FIG. 4.



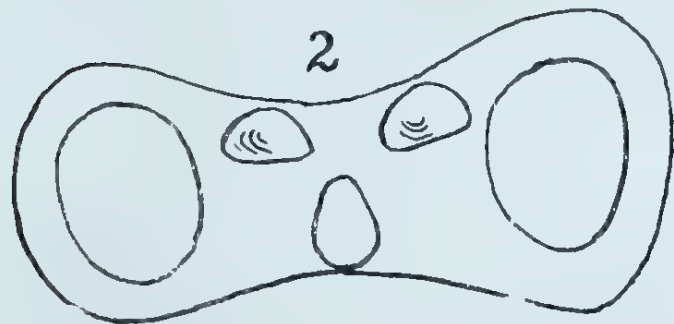
MORSE ON SO-CALLED BOW-PULLERS OF ANTIQUITY.



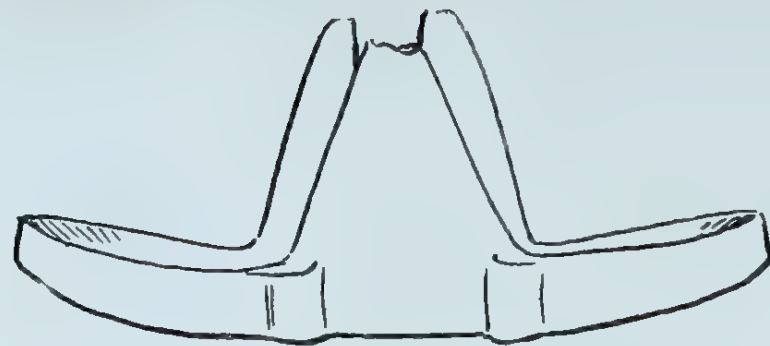
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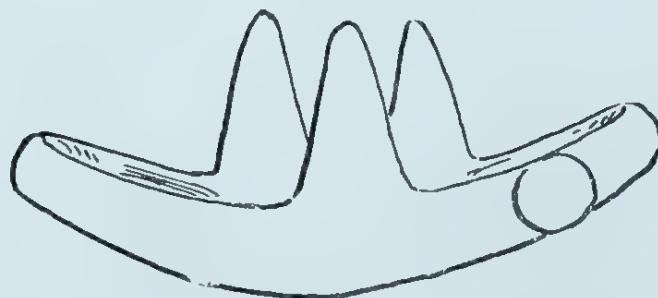
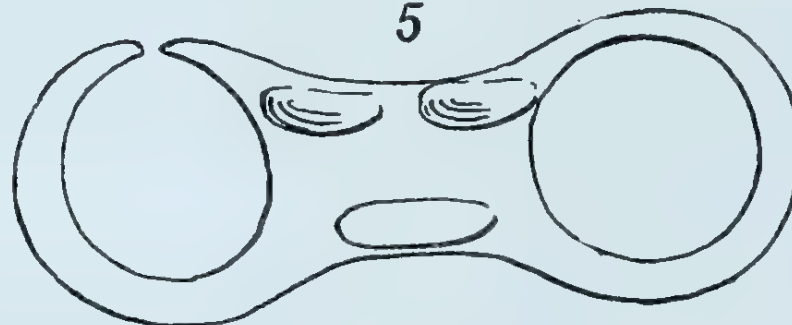
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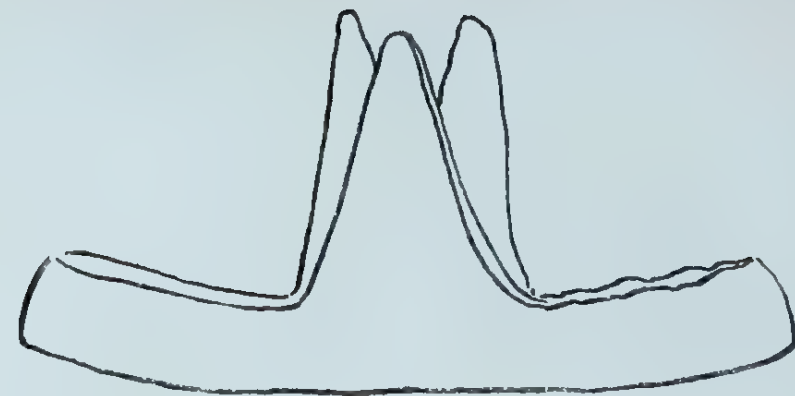
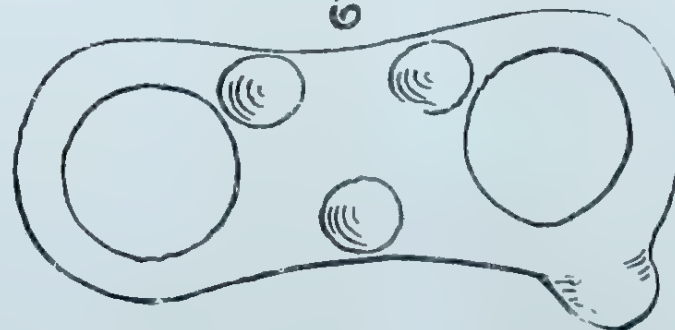
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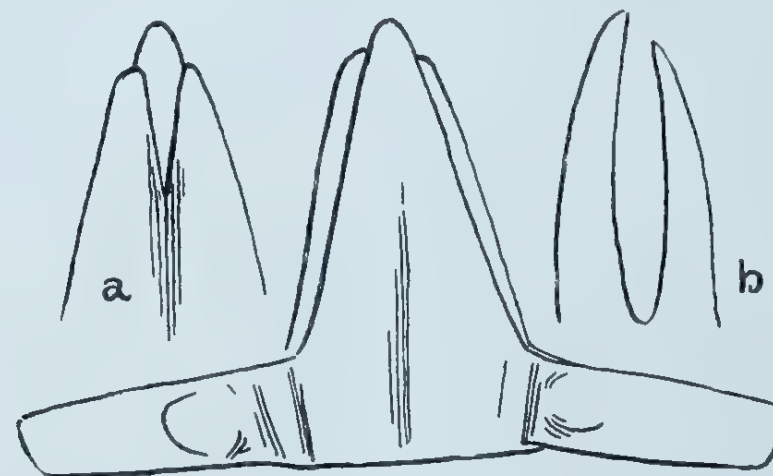
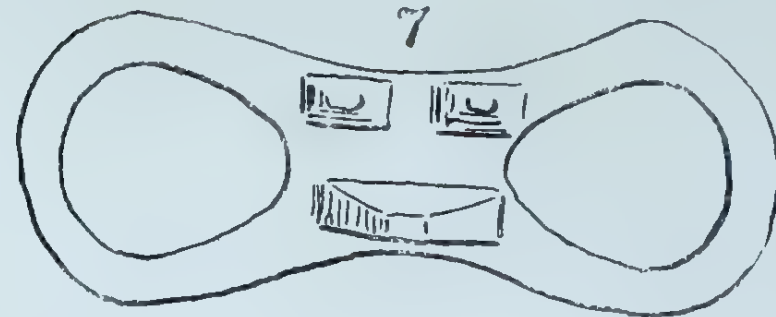
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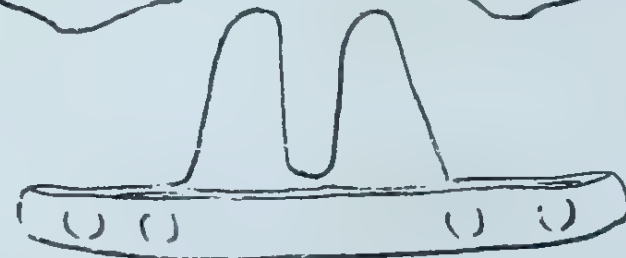
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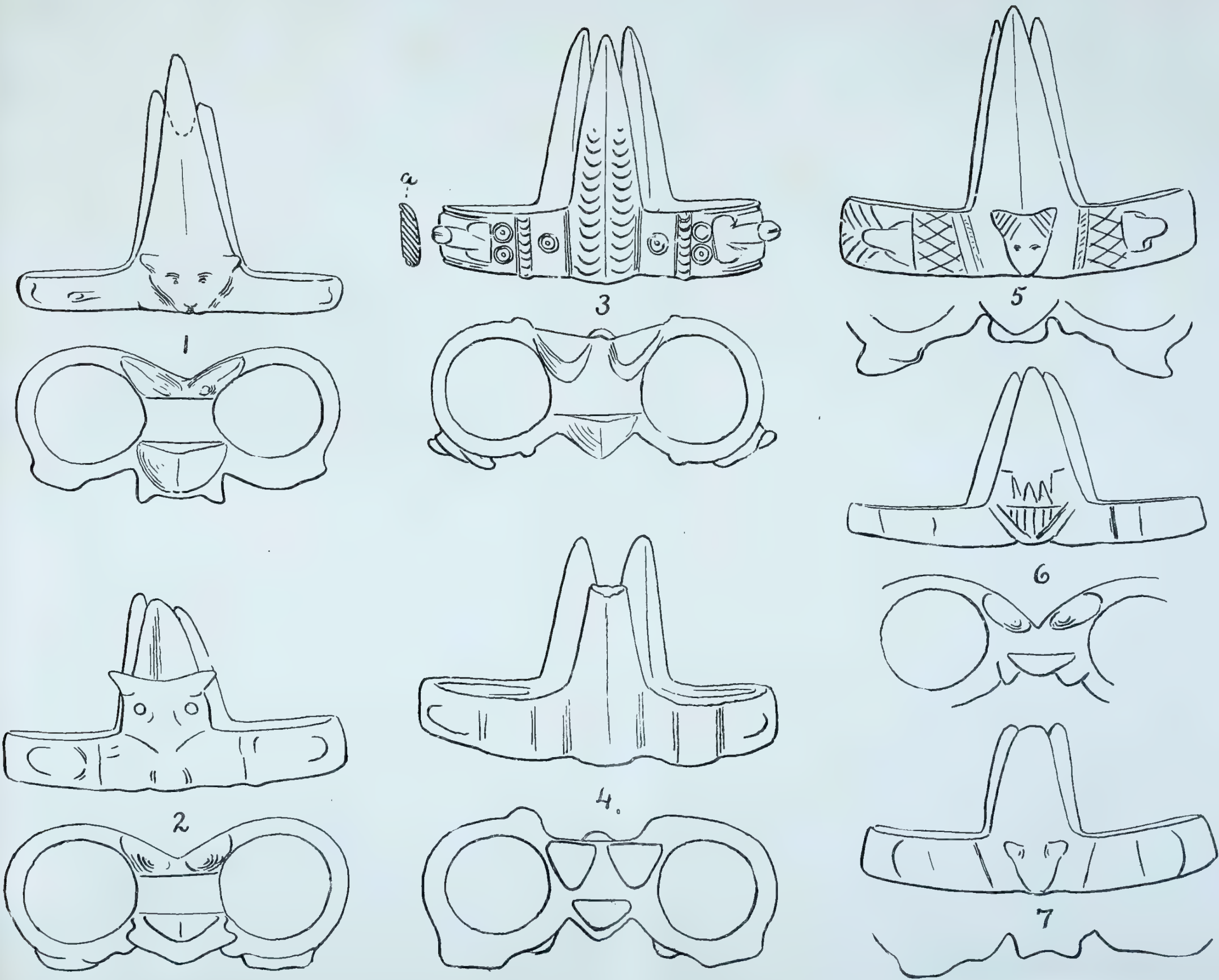
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MORSE ON SO-CALLED BOW-PULLERS OF ANTIQUITY.



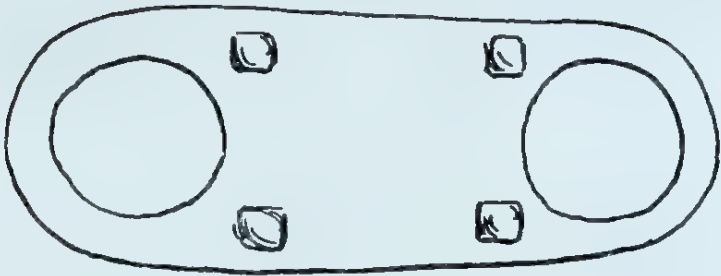
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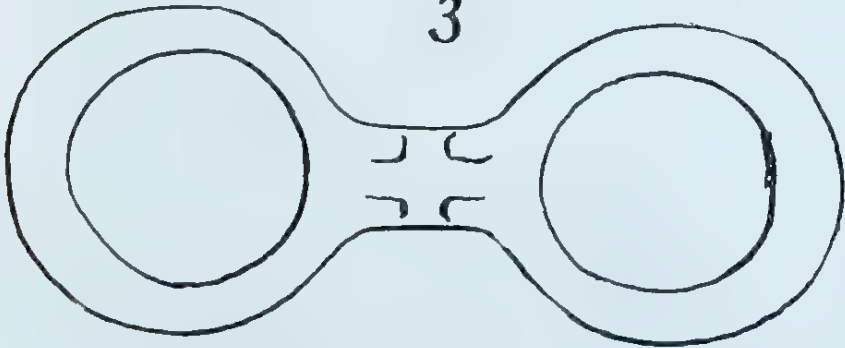
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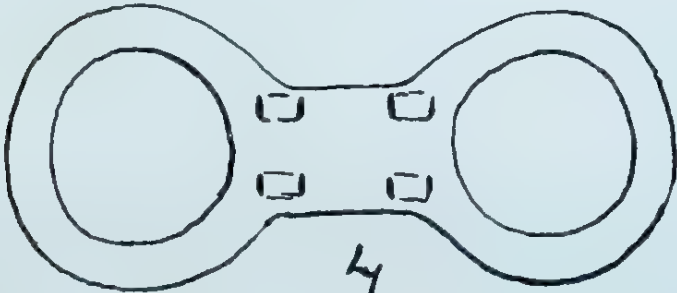
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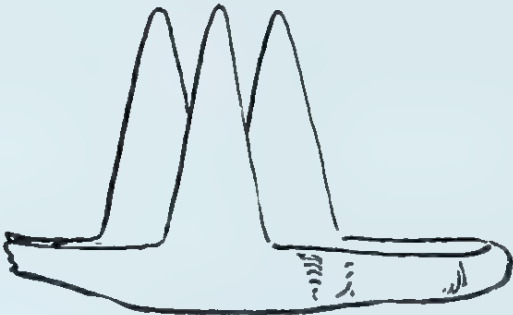
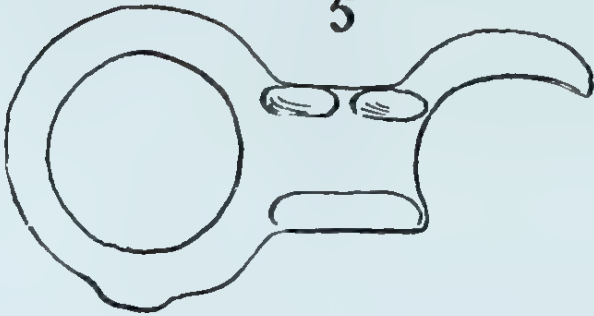
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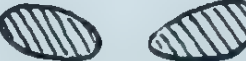
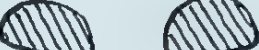
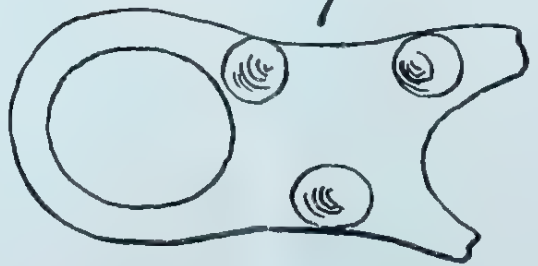
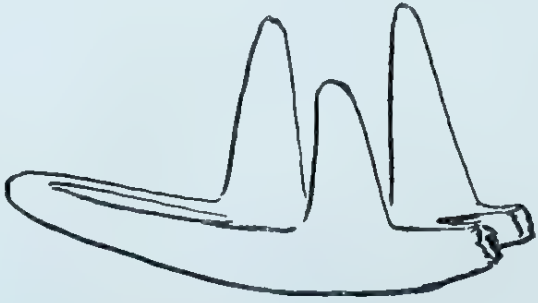
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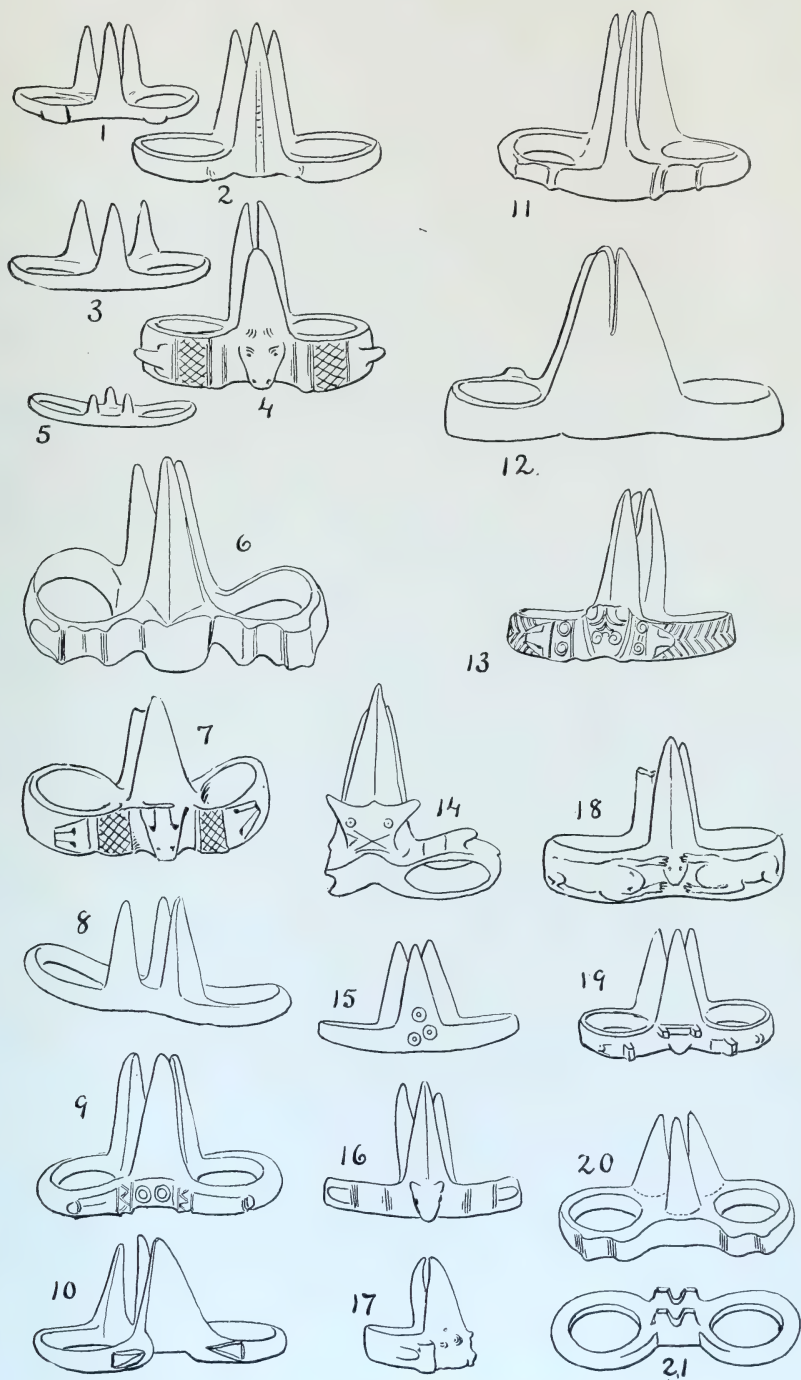


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MORSE ON SO-CALLED BOW-PULLERS OF ANTIQUITY.



MORSE ON SO-CALLED BOW-PULLERS OF ANTIQUITY.

ESSEX COUNTY DIALECT.

BY HELEN MANSFIELD.

The object of this paper is to awaken interest in the dialect of Essex County, to comment a little on some material found there, and to speak of the method of collecting material for the use of the American Dialect Society.

So much has been done in Salem to preserve all that is old, the rest of the county should bow down in gratitude : and no doubt there is much dialect-matter scattered about in your collections awaiting a patient gleaner. That will keep however, since it is already recorded ; while a more urgent matter is the dialect and pronunciation fast vanishing from current speech, and it is very important that attention to the matter should be roused in the county as soon as possible, and that people should be put on the alert to notice and record what comes in their way.

Words come out when no one is thinking of the matter, which could not be extracted from people by *asking* them if they know any queer words, and then we want one of our watchmen at hand to snap up the prize. The older members of the community can tell us of words which were already passing out of use when they were young, and some quite recent usages seem almost incredible.

Fifty years ago Sayward was *Soward* in Gloucester : (always written ay, always pronounced *ow*, as Judge Mitchell says Hayward was in Bridgewater). Goldthwaite was *Goothright* ; Greenleaf was *Gründluf*, (a true umlaut,

suggesting a translated name) ; Tristram was *Trustram* ; Tomlinson was *Tumpleson*, (earliest form, *Tomlins*) : and people said to each other, "Are you going to the *vandue*?" The causeway at Essex is still the *cossey* to some of the "old stand-bys."

The matter of pronunciation is important. I find in Gloucester records, in the older Gloucester speech, and elsewhere, a tendency to sharpen *d* into *t*, *b* into *p*, *v* into *f*, *ng* into *nk*, and so on :—traces, as I think, of ancestors who spoke a more Teutonic tongue than English, namely Dutch or Flemish, (there is little difference) ; and in general the sounds we have been trying to banish, as uncultivated, seem likely to prove relics of an alien speech.

Instances : *Hutson* for Hudson (Concord 1677), *secont* for second ; *Bapson* for Babson, *popple-stones* for pebbles ; (we have a beach, High *Popples*, once a steep terrace of pebbles) ; *Finson* for Vinson, *Medifer* for Madiver ; *Sprinkfield* for Springfield on Boston records, 1684 ; and I have heard natives of that town teased for saying *Sprinkfield*, as I have heard New Yorkers teased for *Hutson*, manifestly a Dutch relic there.

L and *n* were interchangeable, (*m* with them, to some extent ; Tomlinson, *Tumpleson*, *Tumblesome*). Ingersoll was long *Inkerson* on Gloucester records, and seventy years ago the two forms were co-existent. "Aunt Becky Ingersoll," a barber with a famous parrot, used to say, "Between Capt. Jack Ingersoll' and the *Inkersons* about, there's a difference." (They were all of the same stock.) Any man now would sit on the *capson* of the wharf, instead of the capsill.

Final e often served for *y* ; *Luce* and *Stace*, for Lucy and Stacy,—(another Teutonic trait, to understand final *e* as a separate syllable.) *Becca*, *Doratha*, etc., for Becky and Dorothy, was common here, and still prevails in parts

of New Hampshire, settled by Concord and Watertown people. To spell Frothingham and Hildreth *ffrodingham* and *Hildred* shows a Danish strain. (Charlestown and Middlesex.)

This county affords two interesting variations in guttural forms :

1. *Mighill* for Michael among the Cressys and Hopkinsons of Rowley. (Gaelic, an Irish friend says.)

2. A Scotchman, early in Lynn, was written *Arzbell* Anderson, and the historian of Lynn says, "*Arzbell* is right;" but there is no such name. For the *ch* in Archibald they substituted the Teutonic *z*, (sounded *tz*); they left the *i* to be understood; they flattened the *a* with an umlaut into our short *e*; and dropped the *d* after a liquid, like the Danes.

The long Teutonic sound of *oo* was freely used in this county. Different methods of producing our long *o* sound:—Rhodes, Rodes, Roads, *Roods*; rode-line, road-line, *rood*-line; Coates, *Cootes*:—all equivalent.

In 1836 and later a *booby-hut* was running between *Sprinkfield* and Ludlow. Worcester assigns this word to the "East of England," as he does several Essex County words. This is not strange, since two-thirds of all the early settlers are estimated to have come from those parts, but I fancy some of our words had been domesticated there from beyond the channel.

Authorities unite in three statements:—

1. London and the southeast counties were full of refugees from the Netherlands and descendants of refugees.¹

2. London and the southeast counties were always hot-beds of non-conformity.

3. London and the southeast counties furnished two-thirds of the settlers of New England.

¹ May not this very large contingent, with a French habit of pronunciation, be responsible for the "cockney" propping of the *h*?

But they do not seem to have connected these facts very closely, or to see that the sudden prosperity of London after the downfall of Antwerp was largely due to the actual presence in its midst of the men who had made Antwerp, with their greater enterprise and broader views.¹

Weavers, in particular, are always mentioned in connection with Lollardism in earlier times; and weaving was introduced into England by Walloons from Brabant in 1330, although England long continued to play into the hands of Flanders in this important respect. The so-called Huguenots, to whom Queen Elizabeth allowed chapel and workshops in the crypt of Canterbury, were not Huguenots at all, but French-speaking Walloons, silk-weavers from the country round Brussels.

Any connection with cloth I begin to regard with suspicion. I even suspect the Winthrops, "clothiers of Norwich," of being Van Throops or Van Tromps in disguise. Such a descent is quite as honorable as the English, for these were the men who led the world in their time. England rose only on their ruin, and the Dutch Republic still remained far greater than England until William the Third dragged it at the tail of England's kite.

Old Flemish point is very like Honiton; it was Flemish lace-makers who set up the manufacture in Devon. People seem never to have remembered that any one spoke French outside of France, or the Channel Islands. In fact, the Dukes of Burgundy must have introduced much Flemish blood into France in their trains and armies. Barante mentions a representative of the well-known Boston name, *Sohier*, in the service of the Duke of Burgundy at Paris in 1391, "the son of a weaver of Malines."¹ The

¹N. E. Hist. Gen. Reg., vol. XLIX, pp. 24-28. "The Grasshopper in Boston."—p. 28. "Before Elizabeth, almost impossible for the city to raise a loan of £10,000. Before she died it was advancing her loans of £60,000."

Ibid. p. 27. The Gresham crest, a grasshopper, puzzled the experts. The Thach-ers also bear it. I believe it Flemish, one of the quaint conceits of that fun-loving people.

argument for French answers very well for Flemish, for many of them had the two languages, and the Walloon language would seem to be a compound of the two: "French, with Teutonic elements."

I wanted to approach the subject of dialect with you to-day as I approached it myself. About three years ago I became tired of *purring my eyes out* over German text, and took to Dutch, because it was printed in Roman text. Eighteen months later I took to genealogy; and looking over old records and lists of freemen, I found names changing under my eyes according to certain laws which presupposed a Dutch element in the population. Changes, very perceptible to the eye, were no changes at all to the ear of a person who knew ever so little of the sound of Dutch diphthongs, the odd habit of not pronouncing a final syllable in *n*, and of introducing a vowel-sound between consonants where no vowel is written.

Here, I consider, is the cause of the "absurd perversion of proper names which has taken place in this country."² An Englishman, taking down names given him by a Dutchman, would certainly write a vowel where the Dutchman speaks but does not write it,³ and would not write the syllables which the Dutchman writes but does not speak. The Dutch scribe naturally would, and actually did make equal havoc with English names, and he had his opportunity too—("Clark *Vargoose*,"⁴ Boston 1679, and doubtless others earlier.) The English rapidly assimilate foreign names to their own, and I infer that many Flemish names were anglicized before reaching this country, and the Flemings then went on distorting these names according

¹ Barante. "Histoire des Ducs de Bourgogne." Vol. II, p. 130.

² N. E. Hist. Geneal. Register.

³ A Dutchman says *Delft* and *mel-luck*, for Delft and milk.

⁴ Sewall's Diary, vol. I, pp. 53, 108. "Vergoose, Vertigoose, Goose;" (properly Vergoes. Dutch æ=English oo.) "Nurse Goose had another son, Peter, in Norwich, England, and the family was probably not of English origin."

to their command of English. The effect on names of the struggle between two languages is always the same, and to be observed every day in a town like Gloucester, where an ordinary notice in the Post Office must be posted in five or six languages.

The Portuguese Pereira and Rodriguez become *Perry* and *Rogers*. The Swede, Konstanz Mattson, became *Constantia Madison* by accident of deafness in her first mistress. (Later she was *Lena*). Carlsen became *Charlton* by a mistake in shipping papers in England. Clevinhausen became *Hawson* for convenience. If the Virginia name Tagliaferro were spelt *Tolliver*, as pronounced, it would be disguised to the eye; and I suspect a good deal is hidden under many an innocent-looking English name, while Savage and the early freemen's lists show an imposing contingent of foreign blood.¹

But I did not go into genealogy with a bias, although I had read Douglas Campbell's book; for he did not go so far as to say that any of that blood came over here. The first hint came from a *Bethiah* Leach of Manchester, who married in Gloucester in 1685. *Bethiah* seemed a Bible-name, but it was singular in Gloucester. Looking across the line for relatives, I noticed a *Bethia Rea* of Salem Village, and *Rea* recalled the Spanish-Dutch names in Motley. "Is *Bethya* a Bible-name?" Two concordances failed to give it, and I began to suspect a corruption of *Betje* (*Bate'-ya*. Dutch for *Betty*), later mispronounced in three syllables, *Be-thy'-a*.

This single inference may prove a delusion, but it led to observations which are confirmed by Mr. Waters, the experienced searcher, on page 118 of Vol. L, of the New England Historical and Genealogical Register.

¹ John Heard of Dover is John *Hoord* on freemen's list. *Hoorn* may have become *Horne* and *Orne*. Curtis of Boxford was *Curthout*; Grover of Beverly was *Grovwand*, 1734.

And now we can stick more closely to our point;—my first specimen of dialect, (as I suppose it to be), serving to bind the two parts together.

In the year 1714 the inhabitants of Salem petition for help in manning a fort, because, they say, they "have considerable *Lott and Scott* in carrying on the government."¹

In 1687 Gloucester, petitioning against abuses under Andros, complains she has to "pay the *Shott* for the Justices at the Tavern."

In Van Lennep's "Tales of our Ancestors" (Dutch), a crusader says, "it is hard on free citizens who have always paid *schot* and *lot*, to be bandied from one master to another," etc.²

NOTE. *Sch.* hard in Dutch, soft in German; so that the German rendering would be *Shot*, and the Dutch *Scot*.

I do not know if *scot and lot* has been in use in England, but *scot-free* seems to belong to it. The same volume contains "donderkoppén," the *thunder-heads* of New England; and "schmerzengeld," corresponding to the *smart money* sometimes allowed by General Court to wounded Indian-fighters. Other phrases I neglected to mark:—one is always sorry later for an omission of that kind.

About eighteen months ago the Secretary of the Dialect Society wrote a letter to the New York Nation, and spoke of wanting reports from "hill-towns where the population had remained stable, preserving their habits of speech intact." They ran about like ants on their way to the hill-towns, however, as the genealogist soon discovers. It is a task to follow the course of a family from Concord or Watertown, through Sudbury, Grafton, Framingham, Chelmsford, (picking up wives all the way), to a New Hampshire hill-town where it may join another Concord

¹ Essex Institute Collections, vol. v, p. 259.

² "De Reisgeuooten," pp. 244, 345.

stock, which has almost certainly taken in a Scotch-Irish strain on its way through Worcester, Rutland or Londonderry; and it is hardly perched in New Hampshire before it is off for the West.

All these things affect the family speech, and I really think that we of Essex County are stability itself compared with them, especially on the sea-board. The dialect of Marblehead or the Shoals remained the same, I suppose, until it died out; and having just found a few words of it in the Marblehead History, I sent them to the Secretary with some Gloucester words, and referred to the account of the word *schooner* in Worcester's Dictionary. You know the rig and the name are said to have been invented in Gloucester; but even I find it hard to believe that the verb *scoon* was used in Gloucester in 1740, unless it were a Marbleheader who stood by and said, "How she *scoons*!" which is quite possible. I have heard *scoot* used to express haste without grace, but never *scoon*.

I could see no Dutch element in the few Marblehead words I found, unless *pixilated*, (bewildered in the dark), could be connected with *pikzwart*, (pitchdark), which it may not be at all. There was a French element, and I suppose the Cornish strain, manifest there in names beginning with *Tre*, might account for anything. The Marblehead pronunciation quoted by Mr. Chadwick,¹ *barn in a born* for born in a barn, reads like the dialect of Gwenny, the little Cornish maid in "Lorna Doone." John Fisk says Cornish is allied to Gaelic and Welsh, and the last person who spoke it in England died in 1770. Think of carrying a language out of the world in your own person!

The Haskells, who left a numerous progeny in Gloucester, Salem and Marblehead, are said to have *hailed* from

¹ "Harper's Monthly," Vol. XLIX, p. 189.

the Isle of Man. Can it be they who have flooded an innocent country-side with the Americanisms of that Gaelic population! Hall Caine's "Manxman" says, "If a man has done wrong, the next best thing he can do is to say *darned* little about it," and the Manx song about *hunting Jenny Wren*! I wonder if that song has been as familiar everywhere as in this county?

On receiving *rave*, (the rail of a cart), from Sewall's Diary, the Secretary said he had heard it in Eastern Connecticut, but had forgotten to record it. You see we all have valuable words hidden away in our memories; it is a great point gained if we can be on the watch and seize them as they come to the surface. And the older members of the community are invaluable store-houses of pure New England usage; (safer guides than the younger generations, whose heads are full of phrases from all quarters of the earth), and then they may remember words used long ago by only a few old persons, and they had a comprehensive view of a place, too. It would not be possible now to say confidently, "He is the only person in the community who says that," as some one said the other day, speaking of a man who used to come from West Gloucester to sell vegetables in 1825, perhaps. He always said, "Do you want to buy any *whortleberry*-plums?" and everybody else in town said "huckleberry;" but I am told *whortleberry* was not uncommon in Deerfield about that time, and the persons who used it were not trying to be fine.

But in 1810 Gloucester plus Rockport numbered not quite 6,000 souls; now Gloucester minus Rockport numbers nearly 30,000, and all these arrivals tend to "swamp" the native speech. My chief quarrel with them is that they have totally obliterated the auxiliary *shall*. In my young days nobody said *will* for *shall* in Gloucester. It

¹ See "Vinton Memorial."

was New England's boast that she always had it right without thinking of the matter. It is so no longer. Speaking broadly, none of the young people say *shall* at all now. They use *will* in all cases, and their speech is the speech of the future. I hold the schools responsible for a thing like that. They should not permit a pure usage to be driven from one of its strongholds.

I had a strong impression that this county, and particularly the sea-board, had never been very thoroughly looked up by collectors of "Americanisms," and that we should soon have a fine feather in our caps in the shape of a long list of uncollected words. I still hope so, if we can awaken an interest; although a hasty glance into the "Century Dictionary" showed numbers of my words, but not always treated in a satisfactory manner. The much-prized *dun fish*, for instance, is there a compound word: "dun'-fish" and the "process of dunning" is mentioned. No such verb is known in Gloucester, and we object to the hyphen and the accent for the noun. Guy of Warwick did not kill the Dun'cow—he killed the Dun Cow, and Gloucester makes a *dun fish*.

An objection to Worcester's and Webster's definition of *killick* is in the Collections.¹ I sent an abstract of it to the Society, (with proper reference to the Collections.) If I remember rightly, the Century definition was not much better than the other, and to "come to killick" was mentioned as a current phrase. It sounds like Governor Bradford, or Christopher Wood. We of Essex County say, "*I threw my killick over.*"

A subject I should like to see investigated, and which seems to me connected with dialect, is the name *Dogtown*, applied to a high, rolling common in the middle of Cape Ann, which, (the Cape), was never settled except around

¹ Vol. VII, page 36.

the edges. Mrs. Emery¹ mentions a *Dogtown* in the outskirts of Newbury, "a hamlet beyond a belt of trees;" and it seems evident that the name has a common origin, not local. I do not think it has any connection with dogs. I have thought it more likely to be a corruption of syllables no longer understood, and assimilated to something familiar.

"Dialect-Notes" refer to the verb *fudge* used in playing marbles. One writer says it means to cheat; but it seems a particular form of cheating, for another says *fudge* means to push the marbles out of place. In Squam River is a shoal over which boats have to be *fudged* along with a pole, and the place where deep water begins was called *Done Fudging*.² The name extended to the region around, and as a child I supposed it was Dunfudgeon. Thus do things get mixed.

It is not easy to decide whether a word is dialect or not, and luckily it is not necessary for us to do so. It is much safer to report peculiarities, and let the experts decide. They throw out *keeler*, because the word is used wherever the thing is used, but the thing is not used everywhere. No doubt they will throw out *quarrel*, but it will do no harm to report that Judge Sewall used it in Boston 1685-95: "480 *quarrels* of the Front broken by the Hail."³ He says a "house was broken *up*," instead of broken into: (Dutch, *op gebroken*). His *booby-hut* was a coach on runners, while that mentioned above was a clumsy coach on wheels. It might be of importance to the Society to know one was used as late as 1840, and *where* the word survived. And in all cases of doubt, I should say, report rather than risk losing anything.

¹ "Reminiscences of a Nonagenarian."

² History of Gloucester, page 150.

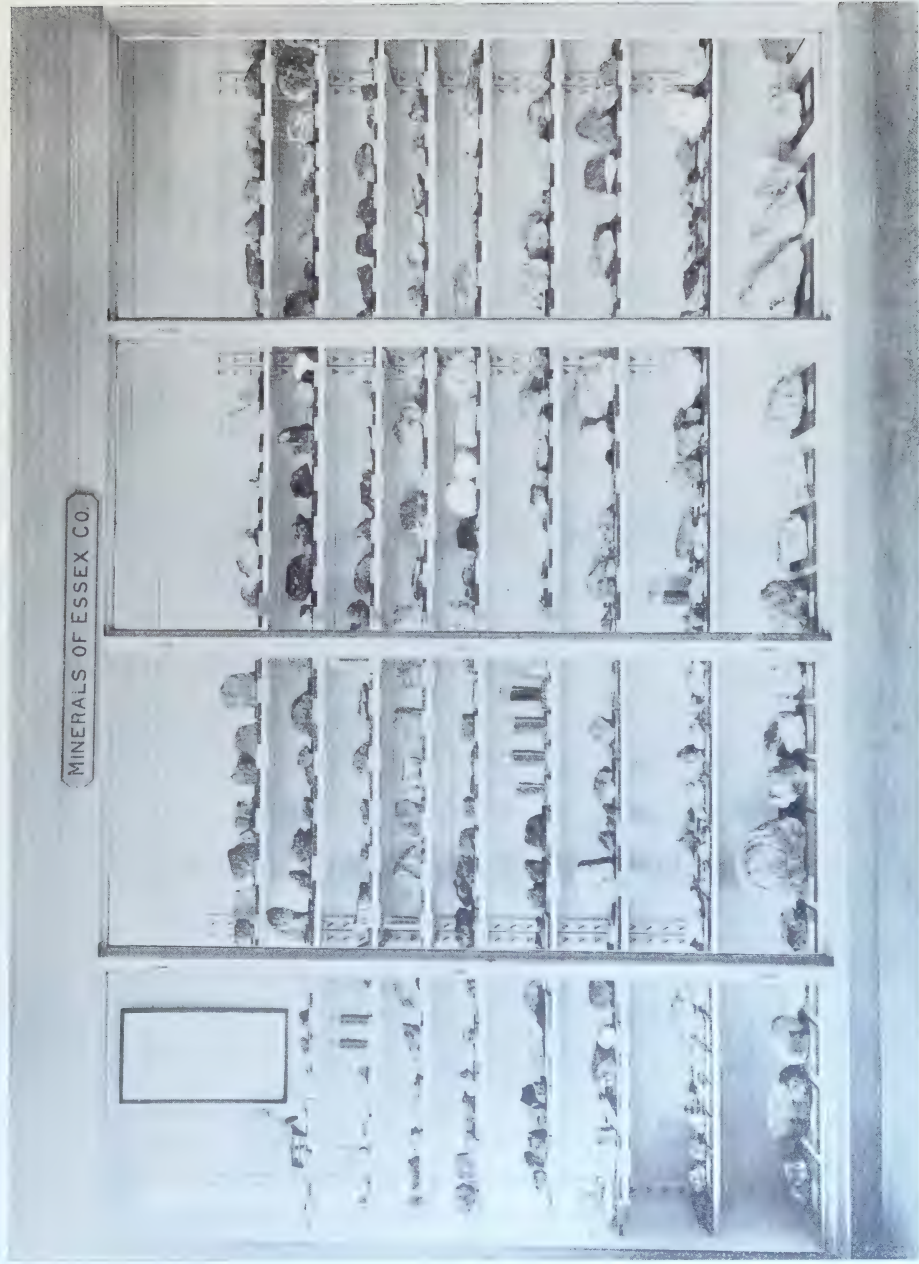
³ Diary, I, 402.

At the annual meeting of the Society, "local pride" was mentioned as an incentive to the work. Essex County is well-entitled to an honest local pride, and Salem before all, for the lead she has taken in all other branches of archæology. She is sure to have a hand in this; and then her fine libraries fit her to be the headquarters of this work;—the last circular having expressed a wish for "local branch-circles at places where the reference-books are accessible." The Society very much wants "more members, more co-operation, and more money for printing," and the Essex Institute's appeal to the county would carry much weight.

Practical: A thin ledger-index, about thirteen inches by four, two pages to a letter, procured of any stationer, is very convenient for recording words.

If a word is taken from a book, note volume and page on entering it. If from a person, enter the name, and the sentence in which you heard it. These precautions save much trouble. Give date of use, if possible—*i. e.*—the time when a word went out of use, came into use, or simply how far back you can trace it. Classes of various kinds, especially of Local History, can without trouble collect much material, by simply saving what comes up naturally in the course of their researches.

A new *meaning*, be it remembered, is as good as a new word.



GEOLOGICAL AND MINERALOGICAL NOTES, NO. 9.

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LIST OF THE MINERALS OF ESSEX COUNTY, MASSACHUSETTS.

THE following list of the minerals of Essex County has been prepared after a careful examination of the work of the earlier mineralogists and diligent search in almost every portion of the county for species not previously noticed. With so few persons devoting themselves to the study of mineralogy or collecting specimens in this region, it is not possible to present an absolutely complete list. Of the minerals here enumerated nearly all are represented by excellent specimens in the County collection in the museum of the Peabody Academy of Science in Salem.

As early as 1821, Prof. J. W. Webster discovered the minerals epidote and fibrous prehnite at Nahant and made analyses of them (*American Journal of Science*, Vol. III, page 364), and in 1823 he discovered the green feldspar and zircon crystals at the hill on the south side of the common in Beverly. In the analysis of the green feldspar he mentions the metallic particles in the compound, which, he writes, are probably oxide of titanium (*Boston Journal of Philosophy*, Vol. I, pp. 390-599). In the *American Journal of Science* (Vol. XXXIV, p. 402, 1838), is

recorded the discovery by Prof. C. U. Shepard, of twelve-sided crystals of columbite and hemitropic crystals of tin ore in the green feldspar rock at Beverly. From examinations of the minerals in the green feldspar rock of Beverly, I am inclined to think that the crystals of tin ore may have been titanite or titaniferous magnetite, as this mineral is quite abundant in the rock,—in fact, it is abundant in all of the varieties of the nepheline and elaeolite-zircon-syenite rocks of the region,—and especially as titanite was not found by Professor Shepard in the analysis of the rock.

In the Essex County Journal of Natural History of 1839, Rev. William Prescott communicated a paper on the mineralogy and geology of the southern part of Essex County. In this paper Mr. Prescott enumerates twenty-nine different minerals and gives the localities in which they were found and their mode of occurrence. On January 14, 1856 (Proceedings E. I., Vol. I, pp. 151–153), Rev. A. P. Chute read a paper and mentioned cancrinite (this so called cancrinite proved later to be sodalite), pyrite and zircon, collected by Gilbert A. Streeter in Salem. In the proceedings of the Institute (Vol. II, p. 47), Mr. Chute gives a list of the minerals of Lynnfield, enumerating fourteen species. This would be a good list from that town at the present time, for a large portion of the bed rock is a Cambrian quartzite, in which there are very few minerals sufficiently conspicuous to be detected without a compound microscope.

In the Proceedings of the American Academy (Vol. VI, 1863, p. 167), Dr. Charles T. Jackson gives the analyses of the green feldspar, fergusonite and rhodonite, and mentions the discovery of minute crystals of topaz in the green feldspar by Mr. Francis Alger of Boston: the minerals were collected at Rockport by the Rev. Stillman Barden of that town.

The rocks from which the minerals recorded in the following list were taken represent twenty-nine distinct rock formations, with several thousand outcropping ledges, in all portions of Essex County. The greater number of these ledges have never been broken into except to collect the few specimens required to determine the character of the rock. They will, therefore, without doubt furnish many mineral species new to the county, as they are worked into and studied, and an extremely interesting field is thus offered to the mineralogist in the future as it has proved in the past.

I desire to acknowledge the kind assistance which I have received in determining many of the minerals here enumerated, from Prof. H. Rosenbusch of the University of Heidelberg, Germany; Prof. S. L. Penfield of the Sheffield Scientific School, New Haven, Conn.; Prof. J. E. Wolff and Messrs. Charles L. Whittle and T. A. Jaggar of Harvard College; Prof. W. O. Crosby of the Boston Society of Natural History; to Mr. John Robinson of the Peabody Academy of Science for other aid, and to the many friends in all parts of Essex County who have so kindly assisted me in procuring specimens, I especially desire to express my thanks.

Peabody Academy of Science.

Salem, July, 1896.

CATALOGUE.

No. 1. Gold.

The gray copper, galena and quartz, from the Chipman silver mine at Newbury, contains gold, and gold has been reported from various other mines in the neighborhood, and also from Boxford, Topsfield, Lynnfield Centre and Saugus. The analysis of the gray copper from the Chipman mine made by Prof. R. H. Richards of the Mass.

Institute of Technology (Proc. Boston Soc. Nat. History, Vol. xvii, pp. 200-204), gives: silver, \$1,422. per ton; gold, \$145.12 per ton and 27 per cent of copper. The galena (30 pounds) from the Chipman mine analyzed by Prof. Richards, yielded 25 lbs. of refined lead, 436.32 grains of silver and 4.19 grains of gold. An analysis of this galena made by myself at the Lawrence Scientific School gave silver at the rate of 27 ounces per ton.

Thus it is seen that gold, silver, lead and copper occur in Essex County. The gray copper of the quality above indicated is very rare even in Newbury and I do not believe that it is to be found in the county in sufficient quantities to be mined at a profit.

No. 2. Graphite.

This occurs in minute foliated scales in the granitic rocks of Peabody and Danvers, and in the slaty, carboniferous shales of Topsfield, Middleton and Lynnfield Centre.

No. 3. Stibnite: Gray Antimony.

Found associated with galena at the Newbury and Newburyport silver mines.

No. 4. Molybdenite.

Found in foliated masses of considerable size at the Pomeroy granite quarry at Gloucester, in the augite-syenite at Salem Neck and some good specimens have been found in the diorite at Marblehead.

No. 5. Silver Ore.

Newbury, Newburyport, Amesbury, Rowley, Boxford and Lynnfield Centre.

No. 6. Galena: Lead Ore.

Found in the same places as the last named.

No. 7. Bornite: Variegated Copper Ore.

Luther Noyes copper mine and the southern part of Kent's Island, Newbury.

No. 8. Chalcopyrites: Copper Pyrites.

Found at the Luther Noyes copper mine, the Chipman silver mine and at Kent's Island, Newbury, the Stephen Osgood mine in South Georgetown and the old Governor Endicott copper mine in Topsfield.

No. 9. Sphalerite: Zinc Blende.

This occurs in considerable masses at all of the mines in Newbury, Newburyport and Rowley, and also in much larger quantities in the John Pettingale mine at Amesbury.

No. 10. Pyrrhotite: nickel Ore.

From the Luther Noyes nickel mine in Newbury and in a small vein exposed in the augite-syenite at Poor House hill in Beverly.

No. 11. Pyrite: Iron Pyrites.

This occurs in large masses near the Harriman mine at Boxford, and in Newbury in connection with the galena and silver ores. This is also common in small quantities in nearly all of the bed rocks of the county.

No. 12. Marcasite: White Iron Pyrites.

Found in large masses at the Luther Noyes nickel mine, Newbury.

No. 13. Arsenopyrite: Mispickel.

This occurs in thin sheets or veins at the John Pettin-gale mine, Amesbury, and good specimens were found at an old mine near the River Parker, Rowley.

No. 14. Tetrahedrite: Gray Copper.

Good specimens of this mineral were found in the dump heaps of the Chipman silver mine, Newbury, and at the Stephen Osgood mine, South Georgetown.

No. 15. Halite: Salt.

Found as incrustations and in acicular crystals on rocks and the borders of tide pools at the sea shore.

No. 16. Fluorite: Fluor Spar.

In irregular, crystalline masses in the granitite at the

quarry of the Rockport Granite Co., Rockport, and associated with galena at Lynnfield Centre.

No. 17. Hematite: Specular Iron.

Found on the surfaces of the slickensides of diorite, Salem, in amphibolite at Putnamville, and in hornblende granites, Peabody.

No. 18. Hematite, var. Micaceous Hematite.

Found in the bed rock of the Tophet hill lost gold mine, Lynnfield, Centre.

No. 19. Hematite, var. Red Ochre.

Beverly Cove, Danvers, Topsfield, etc. This is the common anhydrous form.

No. 20. Menaccanite: Ilmenite: Titanic Iron.

Seen in microscopic patches in nearly all of the eruptive rocks, especially in the augite-syenites, diorites and mica schists.

No. 21. Leucoxen.

This mineral, a decomposition product of the titanite, is usually seen surrounding the titanite or entirely replacing it.

No. 22. Magnetite: Iron.

This occurs in masses in the elæolite-zircon-syenite at Great Haste ledge, Salem harbor, and is common in crystals and small grains in all of the eruptive rocks of the county.

No. 23. Chromite: Chromic Iron.

In octahedral crystals in the limestone and serpentine at the Devil's Basin, Newbury.

No. 24. Rutile.

Common in microscopic crystals in the metamorphic Cambrian rocks in all parts of the county. Larger crystals occur in the granites at Swampscott, West Wenham, etc.

No. 25. Turgite: Red Ochre.

An earthy form of this mineral occurs in a hillside, northwest of the old meeting house, at Beverly Farms.

No. 26. Limonite: Brown Hematite: Bog Iron Ore.

Found in the beds of brooks and small ponds in nearly all of the towns in Essex County. This was the ore used at the Saugus Iron Works, the first iron casting works in America, in 1643.

No. 27. Limonite: Brown Ochre.

Mineral paint mine, Georgetown.

No. 28. Limonite: Yellow Ochre.

Danvers, Topsfield, Newbury, etc.

No. 29. Limonite: Clay Iron Stone.

Good specimens of this mineral are found in pockets in the granite at the Pomeroy quarry, Gloucester.

No. 30. Xanthosiderite.

Found in segregated masses, stalactitic and botryoidal in form, in crevices of the granite at the quarry of the Rockport Granite Co., Rockport.

No. 31. Brucite.

A mineral belonging to the magnesia group, found associated with serpentine at the serpentine ledge, Lynnfield Centre.

No. 32. Wad: Bog Manganese.

Found in large masses in a meadow and brook at Putnamville, and in the form of rounded concretions in small ponds and spring holes at Peabody and Topsfield.

No. 33. Quartz.

Massive vein quartz occurs at North Beverly, Danvers, and various other places in the county.

No. 34. Quartz: Rock Crystal.

Found in large masses and crystals in pegmatite veins at Andover, Nahant, Rockport, etc.

No. 35. Quartz: Drusy Quartz.

In minute crystals, Danvers, Nahant, West Newbury.

No. 36. Quartz : False Topaz.

Light yellow color, Rockport.

No. 37. Quartz : Smoky Quartz.

The massive vein form is found in the rhyolites of Marblehead and in the granitite of Gloucester and Rockport.

No. 38. Quartz : Cairngorm Stone.

Found in nearly black crystals at the Pomeroy quarry, Gloucester, and at Rockport.

No. 39. Quartz : Milky Quartz.

Massive veins occur at South Georgetown and Groveland.

No. 40. Quartz : Ferruginous Quartz.

In the carboniferous slates of Topsfield.

No. 41. Quartz : Rose Quartz.

Occasionally found in the glacial drift.

No. 42. Prase : Actinolitic Quartz.

A vein occurs at Bass Point, Nahant.

No. 43. Chalcedony.

Good specimens occur at Prospect Hill, Beverly, and it is also found filling the amygdules of the amygdaloidal melaphyre at Saugus.

No. 44. Basanite : Chert.

Found in the Cambrian rocks at Peabody, Middleton, Rowley and Nahant Head, Nahant.

No. 45. Jaspelite.

Saugus Centre and Nahant. This is the so called red jasper as popularly known.

No. 46. Quartzite.

Saugus, Lynnfield Centre, etc., forming large beds in the lower Cambrian rockmass.

No. 47. Opal, var. Silicious Sinter.

Found as segregated, granular, stalactitic masses at the contact of the augite-syenite and granite in Beverly.

No. 48. Opal, var. Tripolite : Infusorial Earth.

Found in beds of brooks and meadows in Danvers. At West Boxford beds occur two feet or more in thickness.

No. 49. Hypersthene.

In irregular, cleavable, crystalline grains and masses in the hypersthene-gabbro at Misery Island and Salem Neck.

No. 50. Wollastonite : Tabular Spar.

A bladed variety of this mineral is found at the Devil's Den, Newbury.

No. 51. Diallage.

Found in large crystalline masses at the Luther Noyes nickel mine, Newbury.

No. 52. Pyroxene, var. Augite.

In irregular crystals in the augite-nepheline-syenite at Salem Neck, Beverly and Manchester.

No. 53. Diopside, var. Brown Augite.

This occurs as irregular, microscopic crystals in the augite-nepheline-syenite on the Pickman estate, Beverly Cove.

No. 54. Acmite.

This occurs as small acicular crystals in the augite-syenite at Powder House hill in Essex, and at Lanesville in Gloucester.

No. 55. Ægirine.

Typical bent crystals, sometimes three inches long, are found in the ægirine-syenite at Gale's Point, Manchester. (Sears Bull. Essex Institute, Vol. xxiii, Min. and Geol. Notes, No. 3, p. 5.). It is also seen in thin sections of the elæolite-zircon-syenite of Salem Neck and Beverly when studied with the microscope.

No. 56. Enstatite.

In micro-crystals in the olivine-gabbro of Salem Neck.

No. 57. Bronzite.

Found as the last and also in a coarse pegmatitic mass on Misery Island, Salem harbor.

No. 58. Hornblende.

Irregular crystals are abundant in the hornblende-granite of Peabody and, microscopically, it is common in the diorite, syenites and the dyke rocks.

No. 59. Tremolite.

The Devil's Basin, Newbury.

No. 60. Actinolite.

Long crystals are found at Bass Point, Nahant, and it is also found in a large pegmatite boss in the quarry of the Rockport Granite Co., Rockport.

No. 61. Asbestus, pseudomorph of Actinolite.

A vein, six inches wide, in the diabasic norite, at Bass Point, Nahant.

No. 62. Arfvedsonite: Alkali Hornblende.

Irregular crystals are found at Salem Neck and larger masses on Coney Island, Salem harbor, in the elaeolite-zircon-syenite.

No. 63. Ainigmatite.

Rare, in microscopic masses in the elaeolite-zircon-syenite, Great Haste ledge, Salem harbor.

No. 64. Cossyrite.

Microscopic crystals in the augite-syenite at Magnolia.

No. 65. Glaucophane. A deep blue hornblende.

Massive forms in the augite-hornblende-granite at Pickering's Point, Salem, and in the granite-porphyrity at Marblehead Neck, etc.

No. 66. Chrysolite: Olivine.

Found in porphyritic crystals in olivine basalt dyke rocks, Salem Neck, etc.

No. 67. Fayalite.

A large mass, at a depth of sixty feet, in the quarry of the Rockport Granite Co., Rockport. (See Penfield and



QUARRY OF THE ROCKPORT GRANITE CO., ROCKPORT, ESSEX CO., MASS.

Forbes, American Journal of Science, Vol. 1, 1896, page 129.) The specimens which I collected in 1890 were the first observed in New England.

No. 68. Danalite.

In irregular masses and microscopic blebs scattered through the hornblende-biotite-granite at the quarry of the Rockport Granite Co., Rockport, and at the Pomeroy quarry, Gloucester.

No. 69. Garnet.

Garnet occurs plentifully in a garnet schist outcrop between Powder House hill and White's hill in Essex, and elsewhere in the county.

No. 70. Almandite Garnet.

Abundant in the biotite-muscovite-granite, Andover.

No. 71. Grossularite Garnet: Cinnamon Stone.

In a drift boulder, Nahant.

No. 72. Massive Garnet.

Devil's Den, Newbury.

No. 73. Zircon.

Crystals with double terminations are abundant in the elæolite-zircon-syenite, Salem Neck, Beverly, etc.

No. 74. Vesuvianite.

Specimens from a vein in the serpentine at the Devil's Basin, Newbury, analysed by Prof. W. O. Crosby, were determined as vesuvianite, but the mineral, however, is isotropic and identical with No. 72 above, massive garnet.

No. 75. Epidote.

Veins with fine drusy crystals are found at Egg Rock near Nahant, in the diabase at East Point, Nahant, and also in the rhyolites at Marblehead, Clifton, etc.

No. 76. Allanite.

Radiated crystals are found in the diorite at Beverly, and long slender crystals are found in the augite-syenite at Beverly and West Gloucester and in the granite at Swampscott. The specimen determined as orthite by D.

M. Balch and described in the American Journal of Science and Arts, Vol. xxxiii, p. 198, should undoubtedly be referred to Allanite.

No. 77. Orthite.

Found in radiated crystals in the hornblende-biotite-granitite at the quarry of the Rockport Granite Co., Rockport.

No. 78. Zoisite.

This occurs in fine blue crystalline masses in the zoisite-gneiss and the hornblende-epidote-gneiss at Andover, Georgetown and Newbury.

No. 79. Iolite.

Found in cordierite-gneiss at Marble Ridge, North Andover.

No. 80. Phlogopite Mica.

In granitite, Rockport.

No. 81. Biotite Mica.

In augite-syenite, Salem Neck and Beverly, and also in granitite at Rockport.

No. 82. Lepedomelane.

Found in hexagonal plates of a bronze color in the Pomeroy quarry, Gloucester.

No. 83. Astrophyllite.

In the quarry of the Rockport Granite Co., Rockport.

No. 84. Muscovite Mica.

Common in the biotite-muscovite-granite at Andover, Methuen and Rowley.

No. 85. Lepidolite: Lithia Mica.

In mica schist at Ballardvale, Andover, Bradford and Methuen; in the mica schist at Ward's Hill, Bradford.

No. 86. Cryophyllite.

In the hornblende-biotite-granitite at Rockport.

No. 87. Annite.

Found, as the last.

No. 88. Sericite.



OUTCROP OF ELÆOLITE-ZIRCON-SYENITE, SALEM NECK, ESSEX CO., MASS.

This occurs in irregularly banded plates in the jaspelite at Saugus Centre, etc.

No. 89. Scapolite: Wernerite.

In 1890 I found microscopic grains of scapolite in thin sections of the hornblende-granite collected at a quarry on Humphrey street, Swampscott, which is, I believe, the only record of this mineral being detected in granite.

No. 90. Elæolite.

This occurs in large irregular crystalline masses in the elæolite-zircon-syenite at Beverly, Salem Neck, etc.

No. 91. Nephelite: Nepheline.

Found in small micro-crystals in the augite-nepheline-syenite at Salem Neck, Beverly and Gloucester (See Bull. E. I., Vol. xxv, No. 6, p. 5, 1893.)

No. 92. Cancrinite.

This occurs in minute irregular masses in the elæolite-zircon-syenite at Salem Neck where it is lemon yellow in color. It is more abundant at Great Haste ledge and the Ram Islands, Salem harbor, where the color is grayish to brown.

No. 93. Sodalite.

In coarse pegmatetic masses in the elæolite-zircon-syenite at Salem Neck, Great Haste ledge and Beverly shore.

No. 94. Hydronephelite.

In radiated crystals in the elæolite-zircon-syenite at Salem Neck.

No. 95. Anorthite.

A large mass of this feldspar occurs at East Point, Nahant, near the residence of Hon. H. C. Lodge.

No. 96. Labradorite.

This occurs in large crystals, some of which are three inches long by one and one-half inches wide, in the gabbro at Bay View, Davis Neck and Lanesville in Gloucester, also in porphyretic dyke rocks in various localities.

No. 97. Albite.

Fine, glassy, multiple twinned crystals are found at the Pomeroy quarry, Gloucester.

No. 98 Orthoclase.

Simple and twinned crystals are found in pegmatetic masses in the granitite at Rockport. Common in the granite.

No. 99. Microcline : Amazon Stone.

Specimens of a bright verdigris green color are found at Briscoe hill, Beverly, and at Gloucester and Rockport.

No. 100. Microcline-microperthite (Soda Microcline of Brogger.)

Found in coarse crystalline masses in the elæolite-zircon-syenite at Salem Neck.

No. 101. Orthoclase-microperthite (Albite and Orthoclase intergrowths.)

In the elæolite-zircon-syenite Coney Island, Salem harbor.

No. 102. Sanadin.

Crystals from the Bostonite porphyry (Rosenbusch), a dyke rock on Coney Island, Salem harbor.

No. 103. Anorthoclase.

Crystals in the keratophyre at Marblehead harbor (See Bull. M. C. Z., Geol. Ser., Vol. II, No. 9, p. 167.)

No. 104. Prehnite.

Rare, in reniform or globular masses in the diabasic norite at Nahant.

No. 105. Natrolite.

This occurs as a secondary pseudomorph of elæolite on Salem Neck and in amygdules in the amygdaloidal melaphyre at Rowley.

No. 106. Steatite : Soapstone.

In a massive bed associated with the serpentine at Newburyport.



THE "DEVIL'S DEN," NEWBURY, ESSEX CO., MASS.

No. 107. Talc.

The fine granular variety known as French chalk is found at Newburyport near the silver mines.

No. 108. Serpentine : Noble Serpentine.

Rich oil green color, Devil's Den, Newbury.

No. 109. Serpentine : Common Massive Serpentine.

Devil's Den, Newbury.

No. 110. Serpentine : Foliated Serpentine : Marmolite.

The same station.

No. 111. Serpentine : Picrolite.

Devil's Basin, Newbury.

No. 112. Serpentine : Picrosmine.

Devil's Basin, Newbury.

No. 113. Serpentine : Baltimorite.

Devil's Basin, Newbury.

No. 114. Serpentine : Chrysotile : silky fibrous.

Devil's Basin, Newbury.

No. 115. Serpentine : Massive Serpentine, dark colored variety.

Lynnfield Centre.

No. 116. Kaolinite.

Kent's Island, Newbury, and at "Little Niagara river," Bradford.

No. 117. Tourmaline.

Long accicular crystals, some of which are in finely radiated groups and black in color, are found at South Groveland.

No. 118. Andalusite.

In veins of andalusite slate at Nahant, and near Flax pond, Lynn.

No. 119. Andalusite : Chiastolite.

Crystals are found in glacial drift at the Castle, Castle river, Ipswich.

No. 120. Fibrolite.

In the corderite gneiss at Marble Ridge, North Andover.

No. 121. Titanite: Sphene.

Micro-crystals are found in augite-syenite at Salem Neck, Beverly, Magnolia, etc.

No. 122. Bastite: Schiller Spar.

Resulting from the alteration of pyroxine-diallage in the diabasic norite, Nahant.

No. 123. Pinite.

Pseudomorph of orthoclase; Eagle Island, Little river and Kent's Island, in Newbury, etc.

No. 124. Jeffersite.

In broad crystalline plates resembling biotite mica, northwest side of Powder House hill, Beverly, and in the old lime pits near Stevens' pond, Boxford.

No. 125. Pennenite.

Pomeroy quarry, Gloucester.

No. 126. Delessite.

This occurs as thin folia in seams of diorite at Salem, and in diabase dyke rock in Bradford, etc.

No. 127. Uralite.

A paramorph of hornblende after pyroxene. This mineral is abundant, microscopically, in the quartz-augite-diorite of Newburyport, Carr's Island, etc.

No. 128. Fergusonite.

Found in the granite at the quarry of the Rockport Granite Co., Rockport.

No. 129. Apatite: Phosphate of Lime.

Microscopic crystals occur abundantly in diorite, augite-syenite, and many dyke rocks.

No. 130. Apatite: var. Guano.

Found incrusting the rocks, Great Haste ledge and Half way rock, Salem harbor.

No. 131. Calcite: Calc Spar.

Often found in good rhombic crystals in the amphibolite-gneiss at Putnamville.

No. 132. Calcite : Dogtooth Spar.

Near the Tri-Mountain house, Bass Point, Nahant.

No. 133. Calcite : Massive Granular Limestone.

Found in large masses at the Devil's Den and Devil's Basin, Newbury, and at the old lime pits in Boxford.

No. 134. Calcite : Massive Blue Limestone.

Interstratified with quartzite-sandstone and slate in the carboniferous rocks at Topsfield.

No. 135. Calcite : Statuary Marble.

Specimens, pure white and fine grained, occur at the Devil's Den, Newbury.

No. 136. Calcite ; Silicious Limestone.

This belongs to the Olenellus, Lower Cambrian period and occurs at Archelaus hill, West Newbury, and at Rowley and Nahant.

No. 137. Dolomite : Magnesian Limestone.

Found in veins in the serpentine at the Devil's Den, Newbury.

No. 138. Ankerite.

Good rhombohedral crystals are found in the granitite in the Pomeroy quarry, Gloucester.

No. 139. Magnesite : Brown Spar.

Found in the old serpentine ledge, Lynnfield Centre, and at Boxford and Newbury.

No. 140. Siderite : Spathic Iron.

Massive crystalline forms are found associated with the iron pyrites and galena at the Chipman mine, Newbury, and (rare) in small compound scalenohedrons and rhombic crystals incrusting the albite feldspars at the Pomeroy quarry, Gloucester.

No. 141. Siderite, bronze var.

In the Newbury mining region. The usual form is granular in structure.

No. 142. Malachite : Green Carbonate of Copper.

Found associated with gray copper at the Osgood mine, South Georgetown.

No. 143. Azurite : Blue Carbonate of Copper.

Osgood mine, South Georgetown.

No. 144. Quartz.

A quartz crystal an inch broad, a pseudomorph of fluorite, deep scarlet in color, was found in the granite at the quarry of the Rockport Granite Co., Rockport.

No. 145. Coal : Earthy Brown Coal.

East side of Nahant, near the old iron mine.

No. 146. Bog-butter : Oxygenated Hydrocarbon (?)

Three feet below the surface, Clifton, Marblehead.

No. 147. Rhodonite : Red Bi-silicate of Manganese.

"Rockport, Rev. S. Barden, collector." (Dr. C. T. Jackson, Proc. Am. Acad. Vol. VI, p. 167.)

No. 148. Topaz.

"Determined by Mr. Alger." Same citation as above. Not represented in the collection of the Peabody Academy.

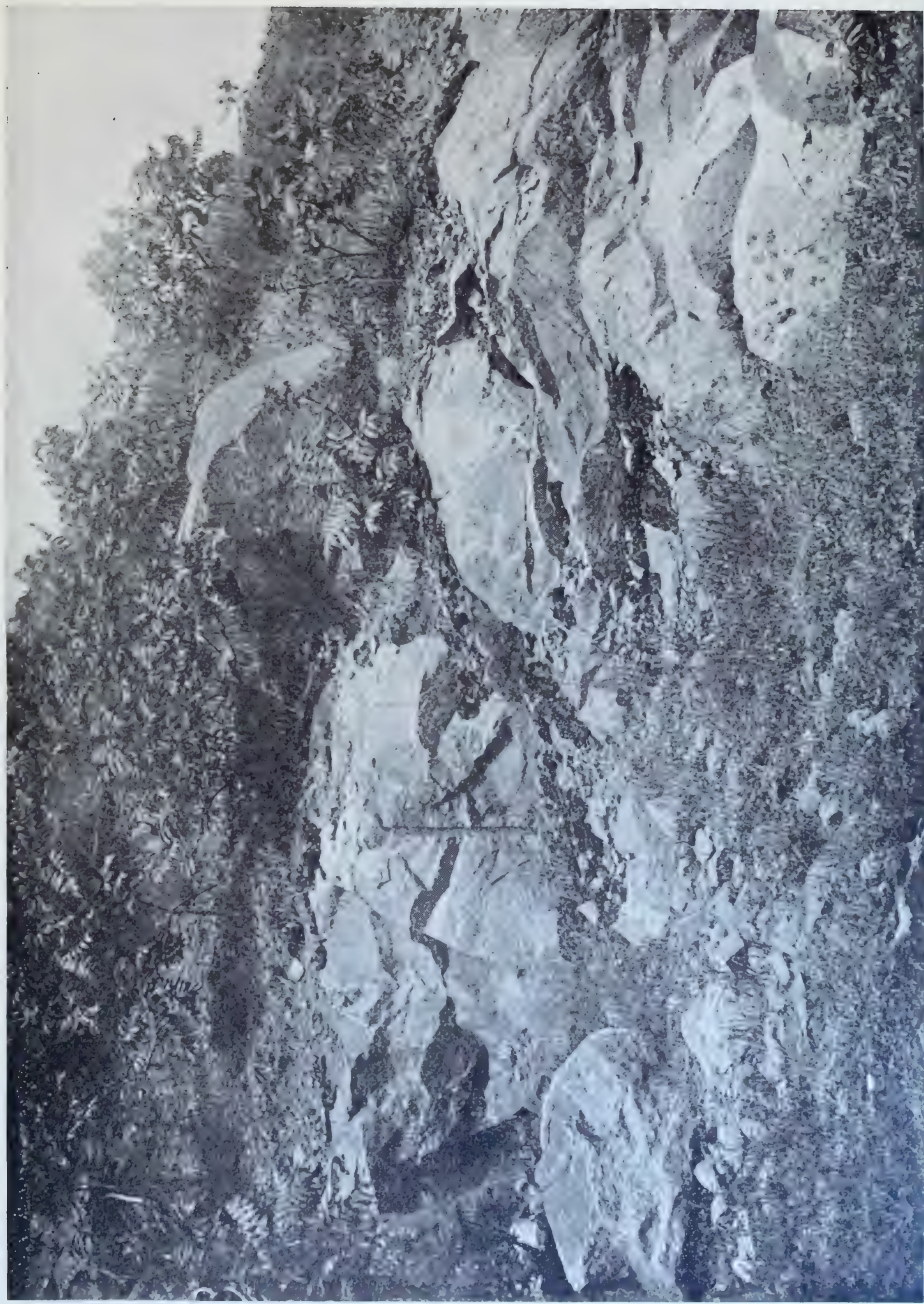
No. 149. Columbite.

"Small twelve-sided prisms of columbite in the green feldspar rock at Beverly" (Prof. C. U. Shepard, American Journal of Science, Vol. XXXIV, p. 402.) Not represented in the collection of the Peabody Academy of Science.

No. 150. Tin Ore.

"Hemitropic (twinned) crystals of tin ore." Same citation. Not represented in the collection of the Academy.

In closing this list I would again call attention to the collection of the minerals of Essex County in the museum of the Peabody Academy of Science, which occupies several sections in the cases devoted to the natural history of the county, and which covers, with the few exceptions noted, all of the species enumerated in the list. A few of



the minerals are only to be seen with the aid of the compound microscope, although abundant in the rocks. The arrangement of the minerals follows the text book of Prof. E. S. Dana, tenth revised edition. In studying the rock formations more than six hundred thin sections were made for microscopic study and these may be seen by persons engaged in the study of the minerals by applying to me at the office on the lower floor of the museum building. In connection with the minerals will be found collections illustrating the rocks of the county and the geological formations, including photographs of the more interesting features. All of the specimens are clearly labelled and can readily be found by anyone who may care to examine them in connection with this list.

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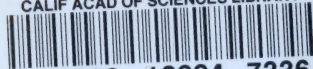
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